

DOCUMENT RESUME

ED 380 588

CE 068 488

TITLE Aerospace and Flight. Technology Learning Activity. Teacher Edition. Technology Education Series.

INSTITUTION Oklahoma State Dept. of Vocational and Technical Education, Stillwater. Curriculum and Instructional Materials Center.

PUB DATE 92

NOTE 169p.

AVAILABLE FROM Curriculum and Instructional Materials Center, Oklahoma Dept. of Vocational and Technical Education, 1500 West Seventh Avenue, Stillwater, OK 74074 (instructional package, one teacher and one student edition, order no. TLA TE2117: \$36; student edition, TE3117: \$13). Superflight Inc., 81 Encino Avenue, Palo Alto, CA 94301 ("Aerobic Aerodynamics" video).

PUB TYPE Guides - Classroom Use - Teaching Guides (For Teacher) (052)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.

DESCRIPTORS *Aerospace Technology; *Aviation Education; Behavioral Objectives; Career Education; Career Exploration; Career Planning; Instructional Materials; Intermediate Grades; Learning Activities; Learning Modules; Secondary Education; State Curriculum Guides; Student Evaluation; Teaching Guides; *Technology Education

ABSTRACT

This packet of technology learning activity (TLA) materials on aerospace and flight for students in grades 6-10 consists of a technology education overview, information on use, and instructor's and student's sections. The overview discusses the technology education program and materials. Components of the instructor's and student's sections are described next. The instructor's section contains background information, suggested activities and resources, and expected learner outcomes. A lesson plan for the 8-day module includes assignments; equipment, tools, and supplies list; and facilities requirements or modifications. The following forms are provided: summary worksheet, pretest, posttest, test answers, and evaluation summary. A bibliography concludes the instructor's section. Topics are as follows: the theory of flight; forces of flight; climbing, gliding, and diving; changing direction and basic movement and control; and constructing flying and Aerobie flying rings. The student section provides materials for each day, including the following: summary of activities, assignments to turn in; goal; vocabulary; expected learner outcomes; list of objectives; list of related Technology Student Association competitive events; and academic and workplace applications reinforced by specific activities in this TLA. An optional activity concludes the student section. (YLB)

Technology Learning Activity



Technology Education Series **AEROSPACE AND FLIGHT**

TLA TE-1117

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Teacher Edition

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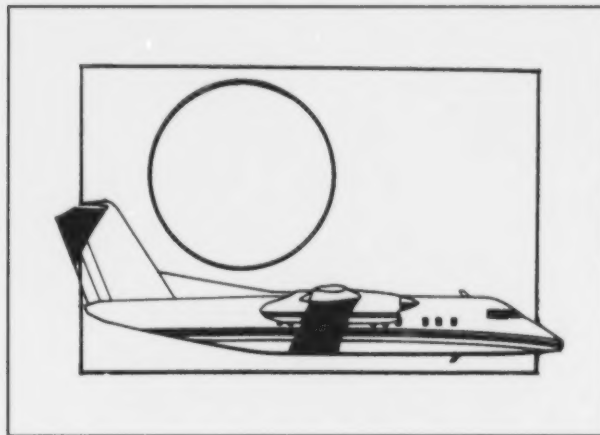
TECHNOLOGY EDUCATION

TECHNOLOGY LEARNING ACTIVITY

TE1117

AEROSPACE AND FLIGHT

Suggested Time: 8 Days



Developed by the
Curriculum and Instructional Materials Center
for the Technology Education Division
Oklahoma Department of Vocational and Technical Education

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Oklahoma Department of Vocational and Technical Education
Stillwater, Oklahoma 74074-4364

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FOREWORD

What will be the careers of the future? The workforce of tomorrow will be shaped by the technologies being developed today. Students today need accurate, interesting information on growing technologies in order to make informed decisions about their futures.

It is our hope that this curriculum will help improve the quality of career decisions for our students. Students are introduced to a wide range of current, "cutting-edge" technologies and are encouraged to think critically about how those technologies influence their lives and futures. Today's students do not have to become the victims of "technological illiteracy," but instead can learn to anticipate technological developments and take positive steps to prepare for the future.

Technology Learning Activities provide students with the knowledge and an introduction to the skills they need for a positive learning and career experience. Every generation is faced with learning how to manage technological advances. Information gained through participation in the *Technology Education* program can help students develop a holistic view of technology on which to base their educational and career decisions.

*Roy Peters, Jr., Ed.D., State Director
Oklahoma Department of
Vocational and Technical Education*

*Roger Stacy, Ed.D., State Supervisor
Technology Education
Oklahoma Department of
Vocational and Technical Education*

PREFACE

We believe that one of the most effective ways to improve education is through the development and implementation of a sound instructional materials system. Technology Education instructional materials represent a new design for CIMC which recognizes the importance of graphic materials in the learning process.

Technology Education instructional materials are designed for 6th through 10th grade students. The design of these materials is based on current research on how people read and gain information from documents. The design is called "New Look" and integrates both graphics and text into a balanced presentation which is easy to use and follow.

Technology Education provides the student a look at what the world will be like in the future based on technologies in use and being developed today. Throughout the Technology Education instructional materials, the students are introduced to "cutting-edge" technologies that they will use and encounter in a working environment later in life. This exposure gives them a wide range of experiences on which to base career decisions.

This publication is intended as a starting point, from which the teacher can innovate, localize, and personalize in order to prepare students for their future. The *Technology Education* series of Technology Learning Activities was written with the realization that we are creating the workforce of tomorrow by how and what we teach about technology today.

*Sherry Wietelman, Curriculum Development Specialist
Curriculum and Instructional Materials Center
Oklahoma Department of
Vocational and Technical Education*

*Charles F. Kemnitz, President
Atlant Communications, Inc.*

ACKNOWLEDGEMENTS

The Curriculum and Instructional Materials Center (CIMC) extends its appreciation to those individuals who played important roles in the development of Technology Learning Activity materials.

Generous thanks is extended to Lynn Hawkins and Jim Harder, both Technology Education teachers at Mayfield Junior High School, for the time, talent and knowledge they contributed in determining the content of this Technology Learning Activity (TLA). We also extend our thanks to them for writing the pilot TLA upon which this TLA was based.

Thank you is also extended to the vocational educators who helped with field testing and contributed their expert input on individualized vocational instructional methods.

Alan Fillmore
Meeker High School

Jerry Lewis
Atoka High School

Ron Givens
Tulsa-Nimitz Middle School

We also thank the State Director, Dr. Roy Peters, Jr., and the Assistant State Director, Dr. Charles O. Hopkins, for their continued support throughout this project.

The school administrators who supported instructor participation in this project and/or allowed their facilities to be used as field test sites in this project deserve a special thank you, as well.

Chris Gillespie
Atoka High School

Brent Walden
Meeker High School

Marolyn Hunnicutt
Tulsa-Nimitz Middle School

Joe Shirley
Mayfield Junior High School

Some of the information in this TLA is reprinted from the Falcon Force Education Kit. We extend our thanks to the Civil Air Patrol for the use of this material.

Oklahoma Department of Vocational and Technical Education
Technology Education staff who provided leadership and direction on
this project also deserve special recognition.

Roger Stacy, Ed.D.
State Supervisor
Technology Education

Donovan Bowers
Assistant State Supervisor
Technology Education

Harold Holley
Assistant State Supervisor
Technology Education

Special Recognition and gratitude is expressed to Dr. Charles F. Kemritz
who trained and coordinated the efforts of a team of technical writers on
this project. His professionalism, dedication and commitment to quality
instructional materials allowed us to design learning activities that
students can readily use to explore new and existing technologies.

Only through the close cooperation of the Curriculum and Instructional
Materials Center staff was this curriculum developed. Sincere thanks are
shared with the CIMC coordinators.

Brenda Stacy, Ed.D.
CIMC Coordinator

Lynna Ausburn, Ph.D.
CIMC Development Coordinator

Special recognition and thanks are also extended to other individuals
within the Oklahoma Department of Vocational and Technical Education
(ODVTE) involved in the development and distribution process: Noel
Wilcoxson, Duane "Frosty" Foster and Diane Ensign and their staffs at the
ODVTE Print Shop; Bob Davis and staff artist Kathryn Moore for the cover
design; Darrell Stiles and his staff in the ODVTE Warehouse for packaging
and coordinating transportation and distribution of these materials; and
Rose Primeaux and her staff in Word Processing.

Finally, a big thank you to all ODVTE team members who offer their
support on a daily basis in "behind-the-scenes" ways but never seem to
be recognized for their contributions: Suzanne Perry and Terri Tomson,
CIMC secretaries; Karen Heppel and Shirley Hill, Technology Education
secretaries.

*Sherry Wietelman
Curriculum Development Specialist
Curriculum and Instructional Materials Center
Oklahoma Department of Vocational and Technical Education*

TECHNOLOGY EDUCATION OVERVIEW

About the Program

Because the American culture is distinctly characterized as technological, it becomes the function of our schools to give every student an insight into and an understanding of the technological nature of the culture. Technology Education strives to perform this function.

Technology Education in Oklahoma is an instructional program that provides young men and women (grades 6 - 10) with daily, hands-on exploratory experiences and insights into technology and career opportunities so that they can make meaningful occupational and educational choices. It is a program which can enhance the educational experience of all students, whether they are the valedictorian/honor-type student, the middle range/average student, or the student who has found little success in school, namely the at-risk student.

Technology Education acquaints all students with their technological environment so they can make rational decisions about their own lives on a day-to-day basis and participate in controlling their own destiny. The program directs students to related technological and industrial fields, enabling students to realize their full potential and make maximum use of their individual talents in fulfilling career goals in their selected areas of employment.

Technology education capitalizes on the individual's potential for reasoning and problem solving, for imagining and creating, and for constructing and expressing through the use of tools and materials related to technology. It develops content and

TECHNOLOGY EDUCATION OVERVIEW

experiences to contribute to the growth and development of students commensurate with their potential. Thus, Technology Education is a basic and fundamental study for all persons in regard to career explorations and educational opportunities.

Opportunities to develop and apply leadership, social, civic, and technologically related skills are provided through the Technology Student Association (TSA). TSA is the appropriate vocational student organization identified as a teaching tool for teachers to use in assisting students to achieve identified course competencies. Competency-based activities are an integral part of the instructional program.

All Technology Education courses are taught in a one-period block of time (45-55 minutes), with each of the four Technology systems (communication, construction, manufacturing, and transportation, energy and power) being designed to provide a means through which other courses such as math, science, English, and social studies can be applied in a practical manner within a technology-based situation. Teaching across the curriculum is vital to the success of a Technology Education program.

TECHNOLOGY EDUCATION OVERVIEW

About the TLAs

The *Technology Education* series consists of 40 Technology Learning Activities (TLAs) for instruction and a supplemental activities book. Each TLA is divided into two parts: an instructor's guide and a student guide. The instructor's guide provides an overview of Technology Education, a summary of activities and supplies needed for students to complete the Technology Learning Activity, a supplies and materials worksheet for the instructor, an overview of the particular TLA, written exam answer sheets, and evaluation summary for the TLA.

Master copies of the evaluation summary sheets, pretest and posttest, and supplies and materials worksheets are provided with this instructors edition of the TLA. These sheets may be reproduced for classroom use.

All of the TLAs focus on measurable and observable learning outcomes. Instructors are encouraged to supplement, personalize, localize, and motivate with these materials in order to develop a complete teaching/learning process.

TLAs are designed for use in more than one class period of instruction. Careful study of each TLA by the instructor will help her or him determine the following:

- »» Skills to demonstrate
- »» Supplies and equipment needed

TECHNOLOGY EDUCATION OVERVIEW

- »» Amount of time needed for student practice
- »» Workstation Bookshelf, Instructors Reference Materials, and a bibliography are provided for supplemental resources
- »» Supplementary materials, including print and non-print media to order
- »» Resource people to contact
- »» Facility modifications which may be necessary to administer the TLA

Each TLA is based on performance objectives. Performance objectives are specific, stating the performances necessary to meet the goal of the TLA.

The overall goal of the unit tells what the student should be able to do and what standard will be used to determine whether the student has achieved competency. The specific objectives outline the sequence of the competencies required to meet the TLA goal. The competencies may be either cognitive, requiring knowledge only, or psychomotor, requiring knowledge and skill.

TECHNOLOGY EDUCATION OVERVIEW

About Ordering TLAs

Additional TLAs in the *Technology Education* series may be ordered through the Oklahoma State Department of Vocational and Technical Education, Curriculum and Instructional Materials Center, 1500 West Seventh Avenue, Stillwater, OK 74074-4364. Phone 1-800-522-5810.

NOTE: *The 1100- and 1200-series numbers given on the next page are for ordering TLA Instructor's Editions; to order Student Editions, change the first two numbers to 31 (for 8-Day TLAs) or 32 (for 6-Week TLAs).*

TECHNOLOGY EDUCATION OVERVIEW

TLA Title	Order No.
8-DAY TLAs	
Aerospace and Flight	TE1117
Agricultural Education	TE1123
Audiovisual Programming	TE1131
CAD — Autocad Release 10	TE1114
Career Search	TE1104
Drafting	TE1134
Electricity — Principles and Applications	TE1105
Electronic Publishing	TE1135
Electronics (CES)	TE1106
Fluidics Technology	TE1116
Health Occupations	TE1124
Home Economics	TE1125
Introduction to VoTech	TE1122
Introduction to Animation	TE1132
Keyboarding and Computer Application	TE1115
Laboratory Safety for Construction Technology	TE1107
Laser/Fiber Optics/Holography	TE1129
Lasers Technology	TE1103
Marketing Education	TE1126
Material Processes — Plastics	TE1133
NASA Aerospace-Spacelink	TE1111
Photography	TE1130
Problem Solving	TE1110
Research and Design	TE1101
Residential Construction	TE1121
Robotics — Control Technology	TE1112
Robotics — ProArm	TE1113
Structural Engineering	TE1102
Synergetic Technology	TE1120
Technical Report Writing	TE1118
Technology Challenge	TE1109
Thermal Screen Printing	TE1119
Trade and Industrial Education	TE1127
TSA Leadership	TE1108
Vocational Business	TE1128
6-WEEK TLAs	
Animator	TE1203
CAD/Board Drafting	TE1201
Control Technology	TE1202
Electronics/Electricity/Robotics	TE1204
Electronic Publisher	TE1205

TECHNOLOGY EDUCATION OVERVIEW

Corrections and Suggestions

CIMC wants to provide Technology Education instructors and students materials that are accurate and effective. Although the CIMC strives to maintain the highest standards of development and production, oversights occasionally do occur. If you find any errors in this or other CIMC publications or have suggestions for improving their usefulness, please notify the CIMC staff. One easy way of pointing out errors is to make a photocopy of the affected page and indicate the correction on the copy. Mail this information to the CIMC, where it will be used to correct the publication before the materials are reprinted.

To ensure that the material is updated on a timely basis, notify the CIMC of necessary corrections as soon as possible. Do not assume that someone else will notice the error and inform the CIMC; other users may be making the same assumption. Please send corrections and recommendations for improving this publication to the following address:

*Curriculum Development Coordinator
Curriculum and Instructional Materials Center
Oklahoma Department of Vocational and
Technical Education
1500 West Seventh Avenue
Stillwater, Oklahoma 74074-4364*

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Background Information

Expected Learner Outcomes

INSTRUCTOR'S SECTION

The background information component provides instructors with basic information about the subject of the TLA. Instructors are encouraged to use suggested resources for additional information on the specific technology used in each TLA.

There are 19 Expected Learner Outcomes for the *Technology Education* series. Not every TLA fulfills all 19 Expected Learner Outcomes, so outcomes specific to each TLA are listed in the Instructors Section and in the Students Section. The 19 Expected Learner Outcomes for the *Technology Education* series are:

- ◆ The student will know and appreciate the importance of technology and technological literacy.
- ◆ The student will explore career opportunities so they can make meaningful occupational choices.
- ◆ The student will explore future educational opportunities so they can make meaningful educational choices.
- ◆ The student will apply problem solving and critical thinking techniques.
- ◆ The student will apply math, science, reading, and other school subjects in a practical situation.
- ◆ The student will develop keyboarding and computer literacy skills.

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INSTRUCTOR'S SECTION

- ◆ The student will develop basic skills in the safe and proper use of tools, machines, materials, processes, and technical concepts.
- ◆ The student will recognize and develop individual talents.
- ◆ The student will think logically and sequentially.
- ◆ The student will develop leadership, creative abilities, positive self-concepts, and individual potential in a technological society.
- ◆ The student will become a more sophisticated consumer of the goods and services of a technological society.
- ◆ The student will adjust to a changing technological environment.
- ◆ The student will develop an understanding and the ability to adapt to those technological forces that influence life in the 21st Century.
- ◆ The student will develop an understanding of economic development.
- ◆ The student will communicate by making clear and relevant points through the development of mental process skills.

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INSTRUCTOR'S SECTION

- ◆ The student will apply design, imagination, and creative abilities.
- ◆ The student will learn applications of lifelong learning skills.
- ◆ The student will think globally and act locally.
- ◆ The student will explore the organization and management systems of business and industry.

Suggested Activities

The suggested activities component is to assist during the preparation stage of the teaching/learning process. The activities provide suggestions for preparation and evaluation during the instructional process. The instructor should read the suggested activities before assigning the TLAs to allow time to obtain supplemental materials, prepare audiovisual materials, and contact outside resource persons. Duties of the instructor will vary according to the particular TLA.

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Suggested Resources

Instructional Sequence

Equipment, Tools, and Supplies: Summary Worksheet

INSTRUCTOR'S SECTION

Suggested resources include people and print and non-print media that may be used with the TLA. References used during the development of each TLA are also provided. The instructor can use suggested resources and TLA references to supplement her or his knowledge of the subject to help students with particular interests or objectives in the area covered. Please note that suggested resources and references listed in this publication existed when this publication was written. CIMC assumes no responsibility for providing these materials and cannot ensure the availability of these materials as individual vendors, manufacturers, and publishers may discontinue these products at any time.

This component provides instructors with daily lesson plans for the TLA. Included in the instructional sequence component are suggested daily assignments and equipment, tools, and supplies that will be needed for each student. A column for facility requirements or modifications is provided for each instructor. This component is provided as a guide to plan for and monitor students' progress through the TLA.

This component is provided as a planning tool for instructors. It provides instructors with a list of the necessary equipment, tools and supplies to support student activities and provides specific information for budgeting purposes.

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Pretest and Posttest

INSTRUCTOR'S SECTION

These components provide criterion-referenced evaluation of the objectives listed in each TLA. If objectives or activities have been added, deleted, or modified, appropriate changes should be made on the tests.

Test Answers

This component is provided to assist instructors in evaluating student performance on written tests.

Evaluation Summary

This component is provided to assist instructors in summarizing the performance of each student on an individual basis. The evaluation summary forms are also provided as photocopy masters for the instructors use.

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Introduction

Summary of Activities

STUDENT'S SECTION

Daily activities are the step-by-step procedures students will follow to complete the learning experience. Each TLA is organized by daily tasks and activities. Students are able to pace their progress through the TLA by referring to the activities for the day.

Within the daily activity pages are components common to all TLAs.

A Summary of Activities page begins each day of the TLA. This page provides several important pieces of information for both the student and instructor.

- ① In the left column this page provides the student with a list of activities to be accomplished that day.
- ② In the right column the major Academic and Workplace Application which applies to that day's activities is graphically indicated with a standard icon.
- ③ Below the icon is a list of specific skills reinforced during that day's activities.

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Pretest Instructions

Assignments to Turn In

Goal

Words You Should Know

STUDENT'S SECTION

The students are required to take a Pretest as one of the first day's activities. The instructions for the Pretest are given in this section.

Day One includes a list of all assignments the students are expected to turn in during or at completion of the TLA. This list includes all tests, activities, and products covered in the TLA.

On Day One, following the assignments checklist, is a concise statement of the overall goal of the TLA. This statement summarizes the purpose for completing the TLA and encourages the student to think about the broader implications of the learning experience.

The first day's activities include a glossary of unfamiliar technical terms used in the TLA. Often these terms are necessary for the student in order to accurately follow instructions in the activity procedures. The students should be encouraged to review this glossary and refer to it often during the course of the TLA.

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Expected Learner Outcomes Reinforced by this TLA

STUDENT'S SECTION

As stated in the guide to the Instructors Section, there are 19 identified Expected Learner Outcomes associated with the *Technology Education* series. This section of Day One activities lists the Expected Learner Outcomes that specifically apply to the TLA. A student who reviews this list will gain a better understanding of the scope of experiences and skills to be gained from the TLA.

Objectives

Each TLA is made up of a set of measurable objectives. In this section on Day One, students are given a list of all the objectives addressed in the TLA. This list can serve to introduce students to the "flow" of the TLA as they build introductory skills in a technology.

Related TSA Competitive Event(s)

Each TLA may be used by students to begin work toward completion of a Technology Student Association competitive event. Some TLAs are tied to a specific TSA event; other TLAs may be used with several events. This Day One section gives the student and instructor a list of appropriate TSA events which the TLA may support.

TSA competitive events promote leadership development, and an understanding that winning isn't everything but involvement is. Events are staged at Local, Regional, State, and National levels through which the student may progress.

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Academic and Workplace Applications

Preparing students to enter successfully into today's world ...

... emergence of a renewed emphasis on basic academic skills ...

STUDENT'S SECTION

The curricular content and activities found in this Technology Learning Activity help students apply academic and workplace competencies. These competencies include: Reading Skills, Writing Skills, Mathematics Skills, Science Skills, Oral Communications Skills, Interpersonal or Relating Skills, Creative Thinking and Problem Solving Skills, Employability Skills, and Social Studies Skills.

Preparing students to enter successfully into today's world of work offers vocational education a substantial challenge. The contemporary workplace is characterized by constant and rapid technological change and by increasing job complexity and skill intensity. Due to rapid technological advancement, the half-life of work skills is now reduced to a bare three to five years. Out of this new workplace environment has arisen a growing national awareness of the critical importance of an American workforce armed with the skills necessary to survive in a competitive economy.

One result of this national awareness has been the emergence of a renewed emphasis on basic academic skills in all areas of education. Pressure to increase academic skill development is being placed on education by both legislative action and industry mandate. The Carl D. Perkins Vocational and Applied Technology Education Act of 1990 sets stringent academic and workplace skill requirements for vocational education. State legislatures are increasingly requiring basic skills accountability by teachers and school administrators.

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... expected learner outcomes are being implemented with increasing frequency.

The issue of basic skills ... was successfully addressed in a national three-year study ...

... research indicates clearly that American employers ... need a variety of skills ...

STUDENT'S SECTION

Graduation exams, minimum competency requirements, and expected learner outcomes are being implemented with increasing frequency. In addition, business and industry are delivering the message clearly to educators that vocational competence now requires increased strength in academic and workplace skills.

The issue of the basic skills currently required in the work place was very successfully addressed in a national three-year study conducted jointly by the American Society of Training and Development (ASTD) and the U.S. Department of Labor (DOL). The findings of this study were published in 1990 in the book, *Workplace Basics: The Essential Skills Employers Want*.

The ASTD/DOL research indicates clearly that American employers have discovered that their workforces need a variety of skills that include, but are not limited to, the classic academic trio of reading, writing, and computation. Employers now are also looking for competence in areas such as "learning to learn," problem solving and critical thinking, interpersonal and teamwork skills, oral communication and listening techniques, and the social and personal management skills that demonstrate a capacity for independence and responsibility in on-the-job performance.

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... business and industry have expanded and re-defined "workplace basics."

CIMC materials contain information and activities which develop academic and workplace application competencies ...

To assist teachers and students in identifying activities which promote academic and workplace skills ...

STUDENT'S SECTION

It is clear that the requirements of today's business and industry have expanded and re-defined "workplace basics." It is in line with this re-definition, and with the competency requirements of current education legislation, that the Oklahoma Department of Vocational and Technical Education has chosen to address "basic skills" in the instructional materials produced by its Curriculum and Instructional Materials Center.

It is not a new development for CIMC materials to contain information and activities which develop academic and workplace application competencies in students undertaking vocational programs. What is new is the specific marking, or flagging, of items in our instructional materials that address academic and workplace application skills.

To assist teachers and students in identifying activities which promote academic and workplace skills development, CIMC has implemented a marking system which uses simple graphic symbols, or icons. These icons are located in the right margins of Activity Sheets. The following is an explanation of the icons and the kinds of academic and workplace application activities they indicate.

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READING SKILLS:

Skills involving use of print resource material for

obtaining and applying information.



WRITING SKILLS:

Skills involving written communication of

processes, information, or ideas.



MATHEMATICS SKILLS:

Skills involving computation, calculation, and interpretation of

numerical data.

STUDENT'S SECTION

Current vocational education literature indicates that functional literacy as a workplace basic needs to be defined in terms of reading competencies actually required for job performance. The activities identified with this icon as addressing reading skills in CIMC materials deal specifically with developing reading skills in an applied, job-related context. These range from general information-gathering activities to tasks requiring use of specific technical reference materials. Many contain a "learning to learn" aspect, which promotes engaging actively and purposefully in vocationally relevant enquiry.

Tasks identified with this icon promote development of skills in written communications. As with reading skills, the writing skills emphasized in CIMC materials have a vocational context. They include filling out forms, keeping work activity records, writing simple memos and letters, generating more complex reports and articles, and written expression of ideas and concepts related to vocational performance or exploration.

This icon identifies activities which develop vocationally-related skills in computation, measurement and estimation, selection and application of appropriate mathematical processes, and collecting, displaying, or interpreting data.

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SCIENCE SKILLS:
Skills involving mastery and application of scientific

information or theory.



ORAL COMMUNICATION SKILLS:

Skills involving speaking

and listening.



INTERPERSONAL OR RELATING SKILLS:

Skills involving

working and getting along with others.

STUDENT'S SECTION

This icon marks activities which are related to the development of skills in either the physical or biological sciences. These skills stress occupationally-related applications of science and technology.

Activities marked with this icon promote development of effective speaking and listening. They include practice in such areas as speaking techniques, word choice, non-verbal messages, use of communication media, and using active listening techniques. Many of these activities promote "learning to learn" skills in verbal enquiry.

Activities which deal directly with skills in relating to others are marked with this icon. This includes areas such as multi-cultural awareness, group processes and dynamics, negotiation, dealing with conflict, cooperation and teamwork, values and attitudes, and leadership and motivation.

USING THIS PUBLICATION



CREATIVE THINKING AND PROBLEM SOLVING SKILLS:

Skills

involving comprehending, applying, analyzing, and developing complex ideas and situations.



EMPLOYABILITY SKILLS:

Skills involving choosing, obtaining,

and succeeding in a career.



SOCIAL STUDIES SKILLS:

Skills involving investigation and

application of social concepts.

STUDENT'S SECTION

This icon identifies activities which stress development of higher-order thought processes such as problem identification and analysis, lateral thinking, evaluating alternatives, developing solutions, examining assumptions, and evaluating outcomes.

Activities marked with this icon relate to competencies required to obtain employment and develop a career. These competencies include specific occupational tasks. They also include items such as career analysis and selection, job searching, completing applications and resumes, interviewing, and business etiquette and personal management skills required for job-keeping and maturing in one's work. Examples of the latter category include personal presentation, self-discipline, work accuracy, reliability, discretion, punctuality, stress handling, judgement, confidence, etc.

This icon marks activities which stress competencies in fields relating to human society and its distribution and relationships. This includes areas such as history, geography, government and politics, economics, psychology, sociology, demographics, current events, cross-cultural studies, consumer issues, environmental issues, and ethical concerns in science and technology.

USING THIS PUBLICATION

Impact Statements

STUDENT'S SECTION

There are five areas of human culture for which each TLA has an impact. These impact statements appear during Day Eight, after the student has gained some familiarity with the technology.

- ① **ENVIRONMENTAL IMPACT:** A statement introducing the student to the impact of the technology on the environment.
- ② **SOCIAL/CULTURAL IMPACT:** A statement concerning the impact of the technology on society and culture.
- ③ **ECONOMIC IMPACT:** A statement concerning the impact of the technology on the economy.
- ④ **POLITICAL IMPACT:** A statement concerning the impact of the technology on politics, laws, and regulations, and the impact of politics on the development of the technology.
- ⑤ **ERGONOMIC IMPACT:** A statement concerning the ergonomic implications of the technology. Ergonomics is the study of developing products and systems that meet peoples' needs.

USING THIS PUBLICATION

STUDENT'S SECTION

Impact Statements offer the student the opportunity to see beyond the activities in the Technology Learning Lab and glimpse the real-world applications of the technology.

Career Search

Also on Day Eight, the students are given the assignment of investigating several career opportunities related to the technology of the TLA. The investigation is done with *Career Search Abstracts*. A list of up to five careers related to the TLA is given, followed by pages from *Career Search Abstracts* that detail the career qualifications and work environment. The student is required to choose two of the five related careers, read the appropriate abstracts, then write a short essay about why those careers may be appealing.

Posttest Instructions

The students are required to take a Posttest as one of the last day's activities. The instructions for the Posttest are given in this section. The score for the Posttest may be compared to the score for the Pretest to help determine the student's gain during the TLA.

USING THIS PUBLICATION

Skunk Works

STUDENT'S SECTION

Skunk Works, a Day Eight optional activity, includes instructions that could be used for solving problems or reinforcing the enrichment of learning.

The term Skunk Works was coined by engineers at 3M Corporation in the mid-1960s. Some engineers wanted to develop a new product, but company management would not give them the time or money to work on the project. So the engineers "borrowed" time and money from approved projects to work on their "Skunk Works." When they finished developing the product, they presented it to management and it has been a 3M product ever since. The product: Velcro fasteners.

HAZARD ALERT MESSAGES

The Daily Activities include hazard alert information specific to the Activity. These messages should be discussed carefully and thoroughly. The Hazard Alert Message system used in the TLA is based on the American National Standards Institute (ANSI) Standard Z535, which provides for five levels of alert.

Students are introduced to the ANSI Hazard Alert Message system as an activity in the Laboratory Safety for Construction Technology TLA (TE1107/TE3107). This system was adopted by ANSI as the standard in 1990 and will be the hazard alert system in use when students reach the workplace.

Hazard Alert Messages in the TLA are indicated both by the color red and graphically. There are three types of hazard alert graphics used in the TLA: the hazard alert symbol, injury hazard graphics, and avoidance graphics.



Hazard Alert
Symbol

This Hazard Alert Symbol is used with the words DANGER, WARNING, and CAUTION. ANSI defines these words as:

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.

HAZARD ALERT MESSAGES



Injury Hazard
Graphic



Avoidance
Graphic

There are two types of graphics used in conjunction with the hazard alert symbol. This type of graphic depicts a specific injury that may be expected if the hazard described in the alert is not avoided.

This second type of graphic is called an avoidance graphic. It depicts an action the student should take in order to avoid injury.

There are two other ANSI words used in the TLAs and the students should understand their meanings:

NOTICE indicates an action that could result in damage to property or equipment.

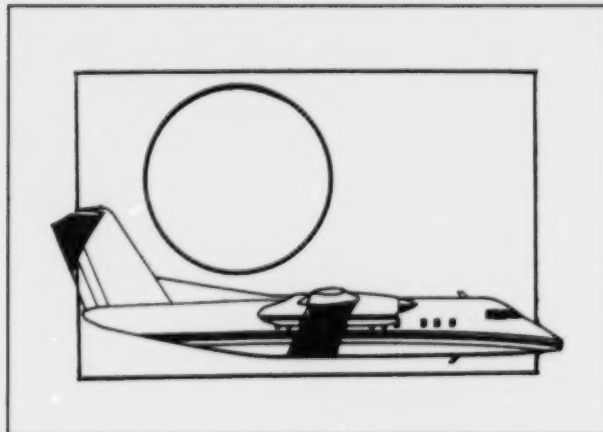
IMPORTANT indicates an instruction that can help the student do a better job.

TECHNOLOGY EDUCATION

AEROSPACE AND FLIGHT

TE1117/TE3117

INSTRUCTOR'S SECTION



BACKGROUND INFORMATION

Aerospace and Flight Technology is the study of the atmosphere and outer space and the study of vehicles that achieve flight in them. It includes the design of those vehicles and the effect the atmosphere has on their flight.

Air transportation was an early contemplation of man. Ancient mythology depicts some of the fantasies about flight of early civilized man. Eventually, man put his fantasies of flight to practical use. The Chinese developed kites in the 4th Century B.C. These were the earliest forms of a flying apparatus. By the middle ages, kite designs were good enough to lift and carry light weight for short distances.

Lighter-than-air flying vehicles were developed and flown during the mid- to late-1700s. These vehicles were balloons with the capability of carrying loads. The balloons were filled with hot air and/or hydrogen gas to provide buoyancy and produce lift for the balloons. In the early 1900s, very large lighter-than-air ships were used to carry cargo and passengers around the world. Hydrogen gas was used in these large air ships, but soon proved to be too hazardous due to its combustible nature. Today, instead of hydrogen, helium is used to fill the blimps that fly the skies and are used commercially.

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INSTRUCTOR'S SECTION

HISTORY OF FLIGHT

Kites

Lighter-than-air vehicles

BACKGROUND INFORMATION

In 1804, Sir George Cayley — the father of aerial navigation — devised the first successful glider. A few years later he built a full-size version of his glider. This second version was able to carry a man short distances. Cayley's 50 years of studies, experiments, and investigations paved the way for the future development of flight.

During the 19th Century, there were many attempts to conquer power-controlled flight. But it wouldn't be until the 20th Century that this goal would be achieved.

Two bicycle shop owners named Wilbur and Orville Wright became interested in flying. They studied the literature and experiments on which Cayley and others spent years working. The Wrights discovered that lateral control of a plane could be obtained by twisting or warping the tips of the wings. They proved their discovery by building, flying and controlling a bi-plane glider. Wing-warping provided balanced flight; front elevators allowed their craft to rise and descend; and the incorporation of a moveable rudder enabled smooth turns. Now, the Wrights had to design and build a suitable engine and devise propellers that would furnish thrust.

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INSTRUCTOR'S SECTION

Gliders

The First Airplanes

BACKGROUND INFORMATION

At Kitty Hawk, North Carolina, on December 17, 1903, a newly-designed plane with a 12-horsepower engine flew. Orville took off into a brisk wind and flew for 12 seconds and traveled 120 feet into the air. Later that day, the plane flew 852 feet in 59 seconds. The next year the brothers were able to fly their plane in a circle. By 1905, they had developed a practical plane that could remain in the air for over 30 minutes.

Due to the success of the Wrights, the use of planes became widespread. Passenger service began in the United States in 1914, and the United States Post Office began air mail service in 1919. World War II prompted new advances in airplane design and manufacturing. One advance in design was the use of jet engines by the Germans. New designs, electronics, and mass-production revolutionized aviation.

The early years of aviation set the stage for the space age. Space travel is now a reality. The study and development of space technology is a new frontier to man. Today, we are challenged with the further development of space travel, with research and experiments being conducted in orbiting space stations, and with the possibility of living in space. These new horizons will provide careers and lifetime occupations for people who are challenged and enthusiastic about space technology.

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INSTRUCTOR'S SECTION

Recent History

BACKGROUND INFORMATION

To understand how airplanes fly, you need to know the characteristics of air. Air is difficult to define because we cannot see it. But it is all around us: filling up every bit of space, including the largest building and the smallest crack. Air is a gas that is both heavy and strong.

We live at the bottom of a vast ocean of air called the **atmosphere** which extends at least 500 miles upward. Because the air on top pushes down on the air below, the pressure at the bottom is very high. This weight of air pushing down on the Earth is called **air pressure**.

Air pressure presses down on everything — on every square inch of land and water, on all living and non-living things, and on the page of this TLA you are reading now. The reason this book does not seem heavy with the weight of the atmosphere pressing down on it, is that there is an equal upward push from the air beneath the book. We sometimes have trouble imagining what this upward push really is, especially since the material doing the pushing is invisible. But the weight of the air not only pushes downward and upward, it also pushes sideward. Air pushes from every direction. You do not feel the weight of the air because the air pressure on all sides of you is the same.

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INSTRUCTOR'S SECTION

THEORY OF FLIGHT

Air

BACKGROUND INFORMATION

Air also resists the movement of things through it. This is called **air resistance**. If you drop a sheet of paper laying flat, it will not fall straight downward because as it falls it is affected by the air resistance. The paper will slide sideways or fall with one edge leading towards the ground. The faster something moves through the air, the greater the air resistance that thing encounters. For example, the faster you ride your bicycle the greater the air resistance you feel. It is air resistance that makes it seem there is a wind on a calm day as you ride.

There are four important forces at work that govern the flight of every plane. **Gravity** is the natural force that pulls the plane toward the ground. **Lift** is the force that pushes a plane upward against the force of gravity. The movement of a plane through the air creates lift. **Drag** is the natural force of air pushing against the plane as it moves through the air. Drag is created by air resistance. **Thrust** is the force that moves the plane forward. Thrust is created by the plane's propeller or jet engines. Once in flight, when a plane's lift equals the force of gravity (the force pushing up equals the force pushing down) and the thrust of the plane equals the drag on the plane, the plane flies level. Whenever any of these four forces change, the plane will change its speed and direction away from an increased force and toward any decreased force.

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INSTRUCTOR'S SECTION

Theory of Flight

BACKGROUND INFORMATION

Planes must be designed so as the plane increases speed the forces of lift and thrust become stronger than the forces of drag and gravity.

A plane must move forward through the air. The force used to move the plane is called thrust. Propeller-driven planes move forward by pushing air backward with the spinning blades of the propellers. Planes without propellers usually use jet engines to get their thrust. Jet engines work somewhat like firecrackers: a stream of hot gases escapes the rear of the engine and pushes the plane forward.

The same escape of hot gases is what moves a bullet when someone fires a rifle. Burning gunpowder creates a force that ejects the bullet. At the same time, the gun pushes back against the person's shoulder. This illustration should help you understand that this kind of forward motion (thrust) is the result of pushing backward. 300 years ago, Sir Isaac Newton discovered that for every action there is an equal and opposite reaction. This discovery became **Newton's Third Law**. By this law, you can see that for every action that pushes gases backward there is a reaction that pushes the plane forward. There is a force that opposes thrust called **drag**. Drag is the result of friction caused by air pushing back against the plane as it moves forward. As the speed of the airplane increases, drag also increases.

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INSTRUCTOR'S SECTION

Thrust and Drag

BACKGROUND INFORMATION

INSTRUCTOR'S SECTION

Thus, in order for a plane to keep moving, the thrust of the plane must overcome the drag. This is not an easy task. For example, when a plane doubles its speed, drag increases four times. To help keep the force of drag small, airplane bodies are built with a sleek, trim shape with all outside parts designed to cut through the air smoothly and easily. The shaping of the outside of an object to reduce drag is called **streamlining**. All airplanes and most automobiles, trains, and trailers are streamlined to help them move through the air more easily.

Moving away from the Earth is not easy because the Earth appears to constantly pull things toward it. That pull is called **gravity**. Gravity pulls on everything in the world every moment. Gravity holds you on the surface of the Earth and pulls down the things you throw into the air. Gravity even pulls at the Earth's atmosphere, which keeps it from flying off into space. When we say something weighs 90 pounds, we mean that gravity is exerting a force of 90 pounds on that thing. **Weight**, then, is the force needed to lift something. Weight increases toward the center of the Earth and decreases as you move away from the Earth. In other words, the force of gravity weakens the farther you get from the Earth.

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BACKGROUND INFORMATION

Gravity pulls things down, but there is another force that can push things back up again. This force is called **lift** and it is caused by the upward push of air. Without lift an airplane could not leave the ground. For a plane to take off and remain in the air, its wings must produce a lifting force strong enough to overcome the downward pull of gravity. Lift is produced by the change of air pressure around the airplane's wing as it moves along the ground or through the air.

Early attempts by man to fly with wings failed because they did not understand that the curved shape of a bird's wings creates lift. After men learned this, they began to build airplane wings that resembled a bird's wings.

When a plane is at rest on the ground, the air pressure above and below the wings is the same. When the plane begins to move forward, air moves over and under the wings. The air moving over the curved upper part flows in a curve while the air moving past the bottom of the wing moves in a straight line. This means that the air passing over the wings must move faster than the air below the wing. The increased speed of the air over the wing reduces the pressure it exerts on the wing. Thus, the pressure exerted by the air beneath the wing is greater than the pressure above the wing.

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INSTRUCTOR'S SECTION

BACKGROUND INFORMATION

When planes move at high speeds, the air above the wing moves quickly enough to reduce the pressure above the wing so that the greater pressure below the wing actually pushes the wings upward. This upward push is lift. As the plane moves more rapidly down a runway, the wings build up more lift. Finally, the air pressure beneath the wings becomes greater than the weight of the plane so the plane rises into the air.

It is important to remember that if the speed of the air moving over and under the wings changes, the amount of lift also changes. Thus, one of the pilot's responsibilities is to see that the right amount of lift is maintained to keep the plane aloft.

More than two hundred years ago, a Swiss scientist named Daniel Bernoulli made an important discovery. He discovered that the faster a gas moved over an object, the less pressure the gas put on the object. The slower the gas moved, the more pressure it put on the object. This discovery is called **Bernoulli's Principle** and, as we have seen, it is the key to flight. Bernoulli's discovery allowed men to design wings that could produce enough lift to rise into the air and remain there.

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INSTRUCTOR'S SECTION

Bernoulli's Principle

BACKGROUND INFORMATION

Altitude is the distance above the Earth. To reach the proper altitude, pilots want their planes to climb, or rise farther above the Earth. Pilots can provide more thrust to the plane by increasing the engine power. The increase in thrust creates more lift and the plane begins to climb. But, climbing creates more drag, so the pilot must provide even more thrust to overcome the added drag.

One way to increase lift is to change the angle of the wings. To do this the pilot must make the entire plane move. If he uses his controls to make the nose point up slightly, the wings will also point up more and the air will strike them in a different way. The angle at which the wings of a plane meet the oncoming air is called the **angle of attack**. When the pilot tilts the plane upward (increases the angle of attack), the distance the air must travel over the wings is greater than before, so the air must travel even faster. The increase in air speed decreases the pressure on top of the wings even more so the pressure on the bottom of the wings can lift the airplane to a greater altitude.

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INSTRUCTOR'S SECTION

AIRCRAFT MANEUVERABILITY

BACKGROUND INFORMATION

To climb, pilots pull back on the control stick to put the wings at a higher angle of attack while he opens the throttle to increase thrust. (The throttle controls the power of the engine like a gas pedal in your car.)

To glide, pilots reduce, or cut, the throttle. As the plane slows, lift decreases and the plane descends.

To dive, pilots push the controls forward. This lessens the angle of attack and noses the plane down.

To maneuver the airplane in any of the ways described above, pilots must control the balance of the four forces of flight. By using their controls, pilots balance lift against gravity and thrust against drag.

Birds, planes, and boats all change their direction in much the same way. A boat has a rudder behind it that is bent against the moving water. Depending on which way the rudder is turned, it gets bumped harder by the water on one side than the other. This bumping swings the front of the boat around in a new direction. Birds use their tails as rudders for turning. When they want to turn left they turn their tails left. The air hitting against the tail turns the bird to the left.

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INSTRUCTOR'S SECTION

Changing Direction

BACKGROUND INFORMATION

INSTRUCTOR'S SECTION

When a pilot wants to turn a plane, he or she uses controls to make parts of the airplane move. Both birds and planes bank as they turn. To bank means to tilt one wing up higher than the other one. Banking makes turning easier and prevents moving off-course in the air. Pilots bank their planes by using ailerons, which are controls on the wings.

The rudder is one part of the tail which moves and assists the ailerons in a turn. The rudder is pressed against the air which is moving around the plane. Using the rudder alone would allow the plane to skid, or slide sideways, just as an automobile does on an icy or wet street.

When an airplane does not have enough lift to keep it in the air, it stalls. This can happen if the pilot points the plane's nose up too high and the angle of attack is too great. Then the air flowing over the wings becomes disturbed — instead of flowing smoothly the air begins to whirl and dance on top of the wing. This turbulent air causes the plane to shudder. The plane then rapidly loses altitude and falls toward the Earth.

To recover from a stall, a pilot lowers the nose of the plane and increases speed. When the plane is moving fast enough, the pilot resumes level flight by bringing the nose of the plane to a level position.

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BACKGROUND INFORMATION

Flying an airplane is different from driving an automobile. Planes do not ride on visible highways. And, when a pilot wants to turn a plane he or she must operate several controls at the same time; whereas car drivers simply turn a wheel.

Airplanes have three basic maneuvers, or movements:

1. pitch;
2. roll; and
3. yaw.

Pitch is the motion of a plane as its nose moves up or down. Roll means that one wing dips lower than the other wing. Yaw is the plane's movement as the nose turns left or right. A pilot uses controls to make these maneuvers or to make adjustments because of them.

Airplanes have many controls. Four important controls are:

1. the elevator;
2. the rudder;
3. the ailerons; and
4. the throttle.

The elevator and rudder are parts of the tail. The ailerons are on the wings. The pilot can move these parts to control the plane. Although they are on the outside of the plane, they are connected by wires or rods to the pilot's controls inside the cockpit.

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INSTRUCTOR'S SECTION

Basic Movements and Controls

BACKGROUND INFORMATION

The pilot turns the rudder with two foot-pedals - one pedal for left turns and the other for right turns. The ailerons and elevator are moved by a stick or wheel in front of the pilot. If the pilot wants to bank right for a right turn, then he or she moves the stick to the right. The right aileron then goes up and the left aileron goes down. The throttle controls the engine's speed and power.

To make any movement in a plane, a pilot seldom uses just one control. By using all the basic controls, the pilot balances lift against gravity and thrust against drag.

INSTRUCTOR'S SECTION

SUGGESTED ACTIVITIES

- ✓ Obtain materials to supplement the TLA.

See Suggested Resources for computer software, books, and videotapes on animation to supplement this module.

- ✓ Review instructional outline for this TLA. Modify time frames to suit class needs and plan activities for each class period.
- ✓ Study the specific objectives to determine those you will cover in your presentation. Decide also which objectives should be taught to which students.
- ✓ Determine the scope and sequence of objectives that you add to the TLA. Design and develop support materials, including evaluation techniques, for additional objectives.
- ✓ Determine how you will schedule time for students to demonstrate competence in the required procedures.
- ✓ Make arrangements for guest speakers. Supply speakers with specific objectives and other appropriate sections of this TLA.

INSTRUCTOR'S SECTION

PREPARATION

SUGGESTED RESOURCES

You, Me, and Technology (Program 11: Exploring Space). Albany, New York: Delmar Publishers, Inc. Videotape.

Ward, Alan. *Flight and Floating*. Tulsa: EDC Publishing. 1981.

Alexander, William, De Old, Alan R., and Everett Sheets. *Transportation: The Technology of Moving People and Products*. Worcester, Massachusetts: Davis Publications, Inc. 1986.

INSTRUCTOR'S SECTION

AUDIOVISUALS

WORKSTATION BOOKSHELF

INSTRUCTOR'S REFERENCE MATERIALS

EXPECTED LEARNER OUTCOMES

INSTRUCTOR'S SECTION

1. The student will know and appreciate the importance of technology and technological literacy.
2. The student will explore career opportunities so he or she can make meaningful career choices.
3. The student will apply problem-solving and critical thinking techniques.
4. The student will apply math, science, reading and other school subjects in a practical situation.
5. The student will develop basic skills in the safe and proper use of tools, machines, materials, processes, and technical concepts.
6. The student will recognize and develop individual talents.
7. The student will think logically and sequentially.
8. The student will adjust to a changing technological environment.

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**EXPECTED LEARNER
OUTCOMES**

**INSTRUCTOR'S
SECTION**

9. The student will develop an understanding of and the ability to adapt to those technological forces that influence life in the 21st Century.
10. The student will communicate by making clear and relevant points through the development of mental process skills.
11. The student will apply design, imagination, and creative abilities.

Instructional Sequence	Technology Education: Aerospace and Flight		
	Assignments	Equipment, Tools, and Supplies	Facilities Requirements/ Modifications
Day 1	Complete Pretest Read Assignments to Turn In: Goal Words You Should Know, Expected Learner Outcomes, Objectives, Related TSA, Competitive Events, Academic and Workplace Applications, and Introduction to Aerospace and Flight	Computer scan card sheet or notebook paper #2 Pencil Notebook paper (1 sheet)	
Day 2	Reinforce Objective 2 Information Sheets: theory of flight Complete Objective 2 Study Questions Read Objective 3 Information Sheets: forces of flight Complete Objective 4 Complete Objective 3 and 4 Study Questions	Computer scan card sheet or notebook paper #2 Pencil Notebook paper (3 sheets)	

Instructional Sequence	Technology Education: Aerospace and Flight		
	Assignments	Equipment, Tools, and Supplies	Facilities Requirements/ Modifications
Day 3	Complete Objective 5 Read Objective 6 Information Sheets: climbing, gliding, and diving Complete Objective 7	Notebook paper (3 sheets) #2 Pencil Balsa fuselage blank, 230 mm long x 75 mm wide x 3 mm thick Balsa wing blank, 300 mm long x 74 mm wide x 1.5 mm thick Balsa stabilizer blank, 75 mm long x 40 mm wide x 1.5 mm thick Metric ruler Cutting board or mat Craft knife T-head pins: 12 Balsa wood model glue 000 sandpaper	
Day 4	Read Objective 8 Information Sheet: changing direction and basic movement and control Complete Objective 9 Complete Objectives 8 and 9 Study Questions	Computer scan card sheet or notebook paper #2 Pencil Balsa glider from Day 3 Stopwatch Paper	

Instructional Sequence	Technology Education: Aerospace and Flight		
	Assignments	Equipment, Tools, and Supplies	Facilities Requirements/ Modifications
Day 5	Complete Objective 10: construct a flying ring	Flat piece of corrugated cardboard for each person working on the TLA #2 Pencil Compass Straight edge or ruler Record sheet (1 per student) 50' or 100' tape measure Flat cutting surface other than workstation table Cutting tool	
Day 6	Complete Objective 11: view Aerobia Aerodynamics	VCR Monitor Video of Aerobia Aerodynamics	
Day 7	Complete Objective 12: make an Aerobie flying ring	Flat piece of corrugated cardboard for each person working on the TLA #2 Pencil Compass Straight edge or ruler Record sheet (1 per student) 50' or 100' tape measure Flat cutting surface other than workstation table Cutting tool	

BEST COPY AVAILABLE

Instructional Sequence	Technology Education: Aerospace and Flight		
	Assignments	Equipment, Tools, and Supplies	Facilities Requirements/ Modifications
Day 8	Read Impact Statements Complete Career Search Activity. Crossword Puzzle, Word Search, Word Jumble, and Posttest	Computer scan card sheet or notebook paper #2 Pencil Notebook paper (1 sheet) Copies of Crossword Puzzle, Word Search, and Word Jumble	
SKUNK WORKS	Build a glider and control its flight	Cutting tool Foam from a deli tray (enough to cut the shapes for the glider) Ball point pen Penny Tape Copy of the pattern for the glider	

SUMMARY WORKSHEET

INSTRUCTOR'S SECTION

61

Equipment, Tools, and Supplies: Summary Worksheet

Equipment, Tools, and Supplies	Per Student	Per Period	Total Needed	Special Considerations	Cost per Student	Cost per Period	Total Cost	Special Considerations
Computer score card/sheet or notebook paper	1 card or 4 sheets							
#2 Pencil	1							
Notebook paper	9 sheets							
Corrugated cardboard	2 pieces							
Compass	1							
Straight edge or ruler	1							
Record sheet	1							
50' or 100' tape measure	1							
Flat cutting surface	1							
Cutting tool	1							
Deli tray foam	enough to cut all shapes in Skunk Works							
Penny	1							
Ball point pen	1							
Tape	1 roll							

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PRETEST

INSTRUCTOR'S SECTION

1. Which of the "Four Forces of Flight" is based on Bernoulli's Principle?

- a. force
- b. lift
- c. thrust
- d. gravity

2. Which of the Four Forces holds you on the Earth?

- a. force
- b. lift
- c. thrust
- d. gravity

3. What does the propeller of an airplane create by pulling the plane through the air?

- a. force
- b. lift
- c. thrust
- d. gravity

4. What is the action of the air that slows things moving through it?

- a. air pressure
- b. air molecules
- c. air resistance
- d. barometric pressure

PART 1

PRETEST

INSTRUCTOR'S SECTION

PART 2

5. Which controls cause planes to pitch upward and downward, and to roll right and left?
 - a. rudders
 - b. ailerons and elevators
 - c. flaps
 - d. fuselage
6. Which of the following statements is Bernoulli's Principle?
 - a. For every action there is an equal and opposite reaction.
 - b. The faster air moves over an object the less pressure put on the object.
 - c. Hot air rises.
 - d. none of the above
7. Which of the following statements is Newton's Third Law?
 - a. For every action there is an equal and opposite reaction.
 - b. The faster air moves over an object the less pressure put on the object.
 - c. Air moves faster when heated.
 - d. none of the above
8. What is the shape of the underside of an airplane wing?
 - a. curved
 - b. oval
 - c. flat or straight
 - d. none of the above

PRETEST

INSTRUCTOR'S SECTION

9. Aerodynamics means:
- a. maneuver
 - b. the study of space
 - c. the study of air as it moves around objects
 - d. none of the above
10. What was the first form of flying apparatus?
- a. kite
 - b. plane
 - c. balloon
 - d. lighter than air machine
11. Who was known as the father of navigation and devised the first successful glider?
- a. Newton
 - b. Orville Wright
 - c. George Cayley
 - d. John Glenn
12. In what year did the Wright brothers accomplish successful flight?
- a. 1980
 - b. 1850
 - c. 1903
 - d. 1780

PART 3

PRETEST

INSTRUCTOR'S SECTION

13. As objects go farther and farther into the atmosphere, the force of gravity does what?
- a. increases
 - b. decreases
 - c. stabilizes
 - d. none of the above
14. Which of the following is not a type of airplane engine?
- a. gasoline engine
 - b. jet engine
 - c. rocket engine
 - d. electrical engine
15. What kind of engine does not require outside oxygen?
- a. jet
 - b. rocket
 - c. gasoline
 - d. turbojet

PART 4

Spaces 16-30 on the answers sheet are used for Objectives 2 and 7 Study Questions.

POSTTEST

INSTRUCTOR'S SECTION

31. Which of the "Four Forces of Flight" is based on Bernoulli's Principle?

- a. force
- b. lift
- c. thrust
- d. gravity

32. Which of the Four Forces holds you on the Earth?

- a. force
- b. lift
- c. thrust
- d. gravity

33. What does the propeller of an airplane create by pulling the plane through the air?

- a. force
- b. lift
- c. thrust
- d. gravity

34. What is the action of the air that slows things moving through it?

- a. air pressure
- b. air molecules
- c. air resistance
- d. barometric pressure

PART 1

POSTTEST

INSTRUCTOR'S SECTION

PART 2

35. Which controls cause planes to pitch upward and downward, and to roll right and left?
- a. rudders
 - b. ailerons and elevators
 - c. flaps
 - d. fuselage
36. Which of the following statements is Bernoulli's Principle?
- a. For every action there is an equal and opposite reaction.
 - b. The faster air moves over an object the less pressure put on the object.
 - c. Hot air rises.
 - d. none of the above
37. Which of the following statements is Newton's Third Law?
- a. For every action there is an equal and opposite reaction.
 - b. The faster air moves over an object the less pressure put on the object.
 - c. Air moves faster when heated.
 - d. none of the above
38. What is the shape of the underside of an airplane wing?
- a. curved
 - b. oval
 - c. flat or straight
 - d. none of the above

POSTTEST

INSTRUCTOR'S SECTION

39. Aerodynamics means:
- a. maneuver
 - b. the study of space
 - c. the study of air as it moves around objects
 - d. none of the above
40. What was the first form of flying apparatus?
- a. kite
 - b. plane
 - c. balloon
 - d. lighter than air machine
41. Who was known as the father of navigation and devised the first successful glider?
- a. Newton
 - b. Orville Wright
 - c. George Cayley
 - d. John Glenn
42. In what year did the Wright brothers accomplish successful flight?
- a. 1980
 - b. 1850
 - c. 1903
 - d. 1780

PART 3

POSTTEST

INSTRUCTOR'S SECTION

43. As objects go farther and farther into the atmosphere, the force of gravity does what?
- a. increases
 - b. decreases
 - c. stabilizes
 - d. none of the above
44. Which of the following is not a type of airplane engine?
- a. gasoline engine
 - b. jet engine
 - c. rocket engine
 - d. electrical engine
45. What kind of engine does not require outside oxygen?
- a. jet
 - b. rocket
 - c. gasoline
 - d. turbojet

PART 4

TEST ANSWERS

1. b
2. d
3. c
4. c
5. b
6. b
7. a
8. c
9. c
10. a
11. c
12. c
13. b
14. d
15. b

1. thrust, lift
2. drag, gravity
3. lift
4. drag
5. lift is equal to gravity and
drag is equal to thrust

16. c
17. b
18. c
19. a
20. c
21. b
22. a
23. b
24. a
25. c

INSTRUCTOR'S SECTION

PRETEST

OBJECTIVE 1 STUDY QUESTIONS

OBJECTIVE 2 STUDY QUESTIONS

TEST ANSWERS

- 26. c
- 27. c
- 28. b
- 29. a
- 30. a
- 31. b
- 32. d
- 33. c
- 34. c
- 35. b
- 36. b
- 37. a
- 38. c
- 39. c
- 40. a
- 41. c
- 42. c
- 43. b
- 44. d
- 45. b

INSTRUCTOR'S SECTION

OBJECTIVE 7 STUDY QUESTIONS

POSTTEST

EVALUATION SUMMARY

5 POINTS EACH

Objective 1: Study Questions _____

Objective 7: Study Questions _____

Day 8: Word Puzzles _____

15 POINTS EACH

Prefest _____

10 POINTS EACH

Objective 2: Study Questions _____

Objective 3: Plan an experiment
and explain your observations _____

Objective 4: Design a glider _____

Objective 5: Build the glider _____

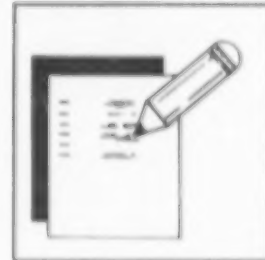
Objective 6: Test, modify, and
record the glider's flight _____

Objective 8: Construct a flying
ring _____

Objective 10: Make and fly your
own Aerobie flying ring _____

INSTRUCTOR'S SECTION

1. PROCESS EVALUATION



1. PROCESS
EVALUATION
SCORE _____

EVALUATION SUMMARY

The instructor is encouraged to individualize the TLA to address the specific needs of each student, considering age and ability level. In addition to the specific areas on the chart below, the instructor should take into account the student's desire, enthusiasm, etc.

EVALUATION RATING TABLE

Student Name: _____

Criteria	Points Possible	Points Earned
Objective 4 Balsa Glider Design:	25	_____
Objective 5 Balsa Glider Appearance:	25	_____
Objective 8 Flying Ring Design Appearance:	25	_____
Objective 10 "Aerobie" Flying Ring Design Appearance:	25	_____

INSTRUCTOR'S SECTION

2. PRODUCT EVALUATION

2. PRODUCT
EVALUATION
SCORE _____

EVALUATION SUMMARY

Posttest Score _____

INSTRUCTOR'S SECTION

3. WRITTEN EVALUATION



3. WRITTEN
EVALUATION
SCORE _____

EVALUATION WORKSHEET

1. Process evaluation score = _____

2. Product evaluation score = _____

3. Written evaluation score = _____

4. Total score = _____

Total Score for TLA =

$$1 + 2 + 3 = 4$$

Total Score /3 = TLA
SCORE

TLA SCORE _____

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INSTRUCTOR'S SECTION

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TECHNOLOGY

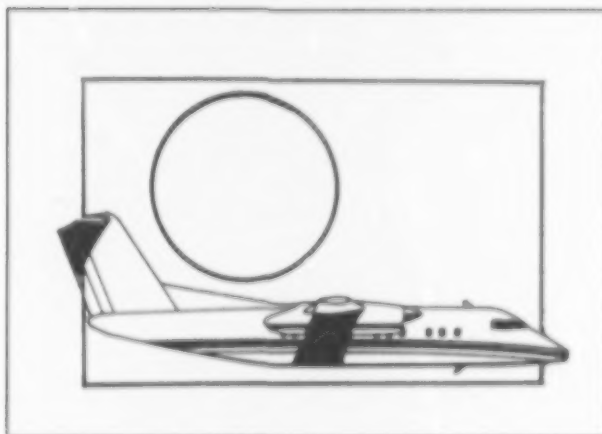
LEARNING

ACTIVITY

TE3117

AEROSPACE AND FLIGHT

Suggested Time: 8 Days



Developed by the
Curriculum and Instructional Materials Center
for the Technology Education Division
Oklahoma Department of Vocational and Technical Education

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Oklahoma Department of Vocational and Technical Education
Stillwater, Oklahoma 74074-4364

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TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



On Day 1 you should complete the following activities:

- ① Complete Pretest
- ② Read Assignments to Turn in (items to complete in 8 days)
- ③ Read Goal
- ④ Read Words You Should Know
- ⑤ Read Expected Learner Outcomes
- ⑥ Read Objectives
- ⑦ Read Related TSA Competitive Events
- ⑧ Read Academic and Workplace Applications
- ⑨ Read Information Sheet

SUMMARY OF ACTIVITIES



Reading Comprehension skills:

- ♦ Gain factual information

Functional Reading Skills:

- ♦ Follow written instructions
- ♦ Interpret graphics and symbols



General Science Skills:

- ♦ Investigate science history

Physical Science Skills:

- ♦ Investigate/apply physical laws

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



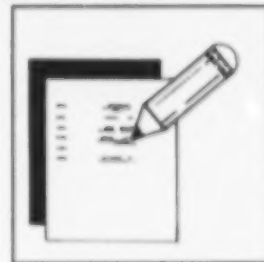
You will need a computer scan sheet or card to record your answers to the following Pretest. Be sure to write your name, the title of the TLA, the date, and the class period on the computer scan sheet or card using a #2 pencil. Use rows 1-10 to record the answers to the Pretest. If your answers will be hand-scored, use a blank sheet of notebook paper to record your answers and number your answers 1-10.

Get Pretest Questions from your instructor.

When you finish the Pretest, return the test form and computer scan card or notebook paper to your instructor.

PRETEST

INSTRUCTIONS



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



At the end of 8 days, you should give the following items to your instructor for evaluation:

1. Computer sheet or card with answers to:
 - a) Pretest
 - b) Day 2 Study Questions
 - c) Day 4 Study Questions
 - d) Posttest
 - e) Spelling Test
2. Study Questions Answers:
 - a) Day 1 Activities: Forces of Flight
 - b) Day 2 Activities: Bernoulli's Principle
3. Glider design and completed glider from Day 3 Activities.

ASSIGNMENTS TO TURN IN

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



4. Written results from your experiments with flying balsa glider from Day 4 Activities.
5. Flight observations and flying Ring from Day 5 Activities.
6. Flight observations and Aerobie flying ring from Day 7 Activities.
7. Career Search Activity
8. Activities from Day 8:
 - a) Crossword Puzzle
 - b) Word Search
 - c) Word Jumble

ASSIGNMENTS TO TURN IN PART 2

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



The Aerospace and Flight TLA will introduce you to the basics of aeronautics. You should be able to use that information to complete each of the assignments in this TLA.

GOAL

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



WORDS YOU SHOULD KNOW

Aerodynamics — the study of the motion of gases and fluids (such as air and water) and objects that move through them (such as airplanes and ships).

Ailerons — flaps on airplane wings that allow the plane to turn left or right.

Air pressure — weight of the atmosphere pushing down on the Earth.

Air resistance — the ability of air to resist movement of things through it.

Altitude — the distance from the ground to an object in the air.

Angle of attack — the angle at which the wings of an airplane meet the oncoming air.

Atmosphere — layers of air that surround the Earth and extend 500 miles upward.

Bank — lift one wing higher than the other.

Climb — motion of an airplane away from the Earth and higher in the air.

Dive — motion of an airplane towards the Earth.

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



WORDS YOU SHOULD KNOW

Drag — a force that opposes the forward motion of airplanes. Drag is a result of friction caused by air resistance.

Elevator — flap on the wing of airplanes that controls the up and down motion of the plane.

Glide — the descent of an airplane without enough engine power to stay in the air.

Gravity — a natural force that pulls objects to the Earth.

Lift — the upward force on an airplane that allows the airplane to overcome gravity and rise into the air.

Pitch — the motion of the nose of a plane as it moves up or down.

Roll — one wing dipping lower than the other when an airplane turns.

Rudder — a flap on the tail of an airplane that assists the ailerons in making a turn.

Stall — loss of lift on an airplane that can allow the airplane to fall to the ground.

Streamline — to design an airplane so that air resistance and drag are reduced.

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



Throttle — control on an airplane that controls engine speed and power.

Thrust — force produced by the jet engines or propellers of an airplane that moves the airplane forward.

Weight — a measure of the force of gravity on an object.

Yaw — movement of an airplane from left to right.

WORDS YOU SHOULD KNOW

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



EXPECTED LEARNER OUTCOMES

- You will know and appreciate the importance of technology and technological literacy.
- You will explore career opportunities so you can make meaningful career choices.
- You will apply problem-solving and critical thinking techniques.
- You will apply math, science, reading and other school subjects in a practical situation.
- You will develop basic skills in the safe and proper use of tools, machines, materials, processes, and technical concepts.
- You will recognize and develop individual talents.
- You will think logically and sequentially.
- You will adjust to a changing technological environment.

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



- You will develop an understanding of and the ability to adapt to those technological forces that influence life in the 21st Century.
- You will communicate by making clear and relevant points through the development of mental process skills.
- You will apply design, imagination, and creative abilities.

EXPECTED LEARNER OUTCOMES

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



At the end of this Technology Learning Activity you should be able to:

OBJECTIVES

OBJECTIVES

1. Correctly answer study questions on the theory of flight based on the Information Sheet.
2. Correctly answer study questions about thrust and drag, gravity, lift, and Bernoulli's Principle based on the Information Sheet.
3. Perform an experiment demonstrating Bernoulli's Principle and explain your observations.
4. Design a balsa wood glider according to TSA specifications.
5. Build the balsa wood glider you designed according to TSA specifications.
6. Test, modify, and record the flight of the balsa wood glider.
7. Correctly answer study questions on maneuvering an airplane based on the Information Sheet.
8. Create a flying ring using the materials and procedure provided.

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



9. Watch the videotape *Aerobie Aerodynamics* to understand how the aerobie flying disc functions.
10. Use the information you gained from *Aerobie Aerodynamics* to make and fly your own Aerobie flying ring.

OBJECTIVES

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



The following TSA Competitive Event applies to your study of Aerospace and Flight:

➤ Aerospace Technology

See *TSA Competitive Events Guidelines* for specific details.

RELATED TSA COMPETITIVE EVENTS

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



The symbols in the right column are used to identify Academic and Workplace Applications reinforced by specific activities in this TLA.

Reading Concepts Applied:

Reading Comprehension Skills:

- ◆ Gain factual information
- ◆ Analyze cause and effect

Research and Reference Skills:

- ◆ Use audiovisual media

Functional Reading Skills:

- ◆ Follow written instructions

Writing Concepts Applied:

Language Skills:

- ◆ Use correct spelling
- ◆ Use correct punctuation
- ◆ Use correct capitalization
- ◆ Use standard grammar

Composition Skills:

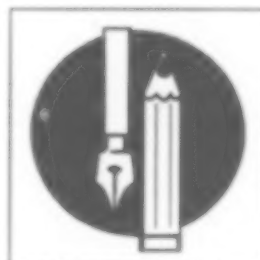
- ◆ Use complete sentences

Math Concepts Applied:

Functional Math Skills:

- ◆ Make measurements

ACADEMIC AND WORKPLACE APPLICATION



— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



ACADEMIC AND WORKPLACE APPLICATIONS

Science Concepts Applied:

General Science Skills:

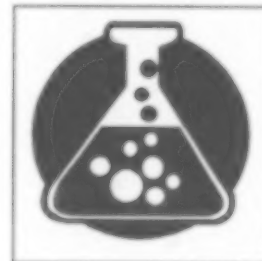
- ◆ Conduct experiments
- ◆ Investigate scientific history
- ◆ Apply technology

Physical Science Skills:

- ◆ Investigate physical laws

Earth Science Skills:

- ◆ Investigate physical forces acting on the Earth



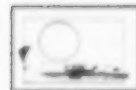
Creative Thinking and Problem-Solving Concepts Applied:

- ◆ Identify underlying causes
- ◆ Draw conclusions
- ◆ Evaluate alternatives
- ◆ Select an alternative
- ◆ Create a finished product
- ◆ Evaluate results/outcomes



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



INFORMATION SHEET

Aerospace and Flight Technology is the study of the atmosphere and outer space and the study of vehicles that fly in them. It includes the design of those vehicles and the effect the atmosphere has on their flight.

Air transportation was an early dream of man. Ancient mythology depicts some of the fantasies about flight of early civilized man. Eventually, man put his fantasies of flight to practical use. The Chinese developed kites in the 4th Century B.C. These were the earliest forms of a flying apparatus. By the middle ages, kite designs were good enough to lift and carry light weight for short distances.

Lighter-than-air flying vehicles were developed and flown during the mid- to late-1700s. These vehicles were balloons with the capability of carrying loads. The balloons were filled with hot air and/or hydrogen gas to provide buoyancy and produce lift for the balloons. In the early 1900s, very large lighter-than-air ships were used to carry cargo and passengers around the world. Hydrogen gas was used in these large air ships, but soon proved to be too hazardous due to its combustible nature. Today, instead of hydrogen, helium is used to fill the blimps that fly the skies and are used commercially.

History of Flight

Kites

Lighter-than-air vehicles

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



In 1804, Sir George Cayley — the father of aerial navigation — devised the first successful glider. A few years later he built a full-size version of his glider. This second version was able to carry a man short distances. Cayley's 50 years of studies, experiments, and investigations helped to make possible the future development of flight.

During the 19th Century, there were many attempts to conquer power-controlled flight. But it was not until the 20th Century that this goal was achieved.

Two bicycle shop owners named Wilbur and Orville Wright became interested in flying. They studied the literature and experiments on which Cayley and others spent years working. The Wrights discovered that lateral control of a plane could be obtained by twisting or warping the tips of the wings. They proved their discovery by building, flying and controlling a biplane glider. Wing-warping provided balanced flight; front elevators allowed their craft to rise and descend; and the incorporation of a moveable rudder enabled smooth turns. Now, the Wrights had to design and build a suitable engine and devise propellers that would furnish thrust.

— continued —

Gliders

The First Airplanes

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 1 ACTIVITIES



At Kitty Hawk, North Carolina, on December 17, 1903, a newly-designed plane with a 12-horsepower engine flew. Orville took off into a brisk wind and flew for 12 seconds and traveled 120 feet into the air. Later that day, the plane flew 852 feet in 59 seconds. The next year the brothers were able to fly their plane in a circle. By 1905, they had developed a practical plane that could remain in the air for over 30 minutes.

Due to the success of the Wrights, the use of planes became widespread. Passenger service began in the United States in 1914, and the United States Post Office began air mail service in 1919. World War II prompted new advances in airplane design and manufacturing. One advance in design was the use of jet engines by the Germans. New designs, electronics, and mass-production revolutionized aviation.

The early years of aviation set the stage for the space age. Space travel is now a reality. The study and development of space technology is a new frontier to man. Today, we are challenged with the further development of space travel, research and experiments being conducted in orbiting space stations, and the possibility of living in space. These new horizons will provide careers and lifetime occupations for people who are challenged and enthusiastic about space technology.

Recent History

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



On Day 2 you should complete the following activities:

- ① Read Information Sheet
- ② Complete Objective 1
- ④ Read Information Sheet
- ③ Complete Objective 2
- ⑤ Complete Objective 3

SUMMARY OF ACTIVITIES

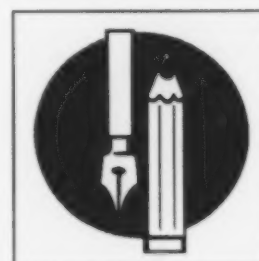


Reading Comprehension Skills:

- ♦ Gain factual information
- ♦ Draw conclusions

Functional Reading Skills:

- ♦ Follow written instructions
- ♦ Interpret graphics and symbols



Language Skills:

- ♦ Use standard grammar
- ♦ Use correct spelling
- ♦ Use correct punctuation
- ♦ Use correct capitalization

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



INFORMATION SHEET

Air

To understand how airplanes fly, you need to know the characteristics of air. Air is difficult to define because we cannot see it. But it is all around us: filling up every bit of space, including the largest building and the smallest crack. Air is a gas that is both heavy and strong.

How much does air weigh? The air inside an empty suitcase weighs about as much as a silver dollar. And all the air in your living room weighs more than the average person.

We live at the bottom of a vast ocean of air called the **atmosphere** which extends at least 500 miles upward. Because the air on top pushes down on the air below, the pressure at the bottom is very high. This weight of air pushing down on the Earth is called **air pressure**.

Air pressure presses down on everything — on every square inch of land and water, on all living and non-living things, and on the page of this TLA you are reading now. The reason this book does not seem heavy with the weight of the atmosphere pressing down on it, is that there is an equal upward push from the air beneath the book. We sometimes have trouble imagining what this upward push

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



really is, especially since the material doing the pushing is invisible. But the weight of the air not only pushes downward and upward, it also pushes sideward. Air pushes from every direction. You do not feel the weight of the air because the air pressure on all sides of you is the same.

Air also resists the movement of things through it. This is called **air resistance**. If you drop a sheet of paper laying flat, it will not fall straight downward because as it falls it is affected by the air resistance. The paper will slide sideways or fall with one edge leading towards the ground. The faster something moves through the air, the greater the air resistance that thing encounters. For example, the faster you ride your bicycle the greater the air resistance you feel. It is air resistance that makes it seem there is a wind on a calm day as you ride.

Have you ever watched a large jet airplane roll down the runway for a takeoff? The jet moves faster and faster along the runway and then it rises in the air and begins to climb. What makes the airplane go up? Why does it stay up?

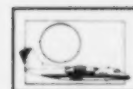
There are four important forces at work that govern the flight of every plane: gravity, lift, drag, and thrust. Gravity is the natural force that pulls the plane toward

Theory of Flight

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



the ground. **Lift** is the force that pushes a plane upward against the force of gravity. The movement of a plane through the air creates lift. **Drag** is the natural force of air pushing against the plane as it moves through the air. Drag is created by air resistance. **Thrust** is the force that moves the plane forward. Thrust is created by the plane's propeller or jet engines. Once in flight, when a plane's lift equals the force of gravity (the force pushing up equals the force pushing down) and the thrust of the plane equals the drag on the plane, the plane flies level. Whenever any of these four forces change, the plane will change its speed and direction away from an increased force and toward any decreased force. This change in speed and direction is called a change in velocity.

Planes must be designed so as the plane increases speed the forces of lift and thrust become stronger than the forces of drag and gravity. The pilot of a plane controls the lift and thrust by the way he uses the parts of his plane. Pilots control the different parts of a plane from the cockpit. Pilots use many instruments and tools while flying their planes. The instruments and tools function much like the steering wheel, pedals, and dashboard of your family car.

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



Correctly answer study questions on the theory of flight based on the Information Sheet.

To answer these questions you need a #2 pencil and a blank sheet of notebook paper. Read each question and write your answer on the notebook paper.

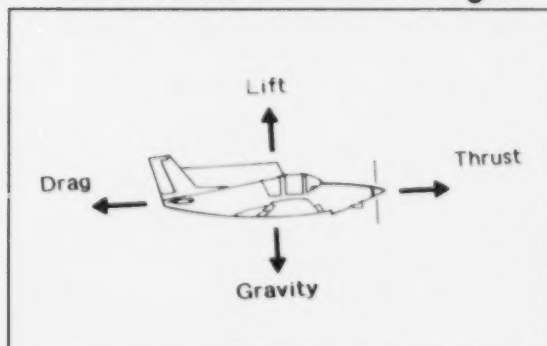
OBJECTIVE 1

INSTRUCTIONS



STUDY QUESTIONS

1. What two forces work for an airplane?
2. What two forces work against an airplane?
3. Which force opposes gravity?
4. Which force opposes thrust?
5. If an airplane flies straight and level at a steady speed, how would you describe the four forces of flight?



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



INFORMATION SHEET

Thrust and Drag

Airplanes are much heavier than air, but they can fly. A large jet airplane weighs about 700,000 pounds, yet it can carry passengers and tons of baggage into the air and then return safely to the ground.

To begin its adventure, a plane must move forward through the air. The force used to move the plane is called thrust. Propeller-driven planes move forward by pushing air backward with the spinning blades of the propellers. Planes without propellers usually use jet engines to get their thrust. Jet engines work somewhat like firecrackers: a stream of hot gases escapes the rear of the engine and pushes the plane forward.

The same escape of hot gases is what moves a bullet when someone fires a rifle. Burning gunpowder creates a force that ejects the bullet. At the same time, the gun pushes back against the person's shoulder. This is an example of thrust resulting from pushing backward. 300 years ago, Sir Isaac Newton discovered that for every action there is an equal and opposite reaction. This discovery became **Newton's Third Law**. From this law, you can see that for every action that pushes gases backward there is a reaction that pushes a plane forward.

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



There is a force that opposes thrust called **drag**. Drag is the result of friction caused by air pushing back against the plane as it moves forward. As the speed of the airplane increases, drag also increases. Thus, in order for a plane to keep moving the thrust of the plane must overcome the drag. This is not an easy task. For example, when a plane doubles its speed drag increases four times. To help keep the force of drag small, airplane bodies are built with a sleek, trim shape with all outside parts designed to cut through the air smoothly and easily. Shaping the outside of an object to reduce drag is called **streamlining**. All airplanes and most automobiles, trains, and trailers are streamlined to help them move through the air more easily.

Moving away from the Earth is not easy because the Earth appears to constantly pull things toward it. That pull is called **gravity**. Gravity pulls on everything in the world every moment. Gravity holds you on the surface of the Earth and pulls down the things you throw into the air. Gravity even pulls at the Earth's atmosphere, which keeps it from flying off into space.

We have developed a method of measuring the downward pull of gravity. When we say a thing weighs 90 pounds, we mean gravity is exerting a measure of 90 pounds on that thing. **Weight** is the force needed to lift something.

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



Weight increases toward the center of the Earth and decreases as you move away from the Earth. In other words, the force of gravity weakens the farther you get from the Earth.

Gravity pulls things down, but there is another force that can push things back up again. This force is called **lift** and it is caused by the upward push of air. Without lift an airplane could not leave the ground. For a plane to take off and remain in the air, its wings must produce a lifting force strong enough to overcome the downward pull of gravity. Lift is produced by the change of air pressure around the airplane's wing as it moves along the ground or through the air. (You will read about this in the next section on "Bernoulli's Principle.")

Early attempts by man to fly with wings failed because they did not understand that the curved shape of a bird's wings creates lift. After men learned this, they began to build airplane wings that resembled a bird's wings.

When a plane is at rest on the ground, the air pressure above and below the wings is the same. When the plane begins to move forward, air moves over and under the wings. The air moving over the curved upper part flows in a curve while the air moving past the bottom of the wing

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



moves in a straight line. This means that the air passing over the wings must move faster than the air below the wing. The increased speed of the air over the wing reduces the pressure it exerts on the wing. Thus, the pressure exerted by the air beneath the wing is greater than the pressure above the wing. When planes move at high speeds, the air above the wing moves quickly enough to reduce the pressure above the wing so that the greater pressure below the wing actually pushes the wings upward. This upward push is lift. As the plane moves more rapidly down a runway, the wings build up more lift. Finally, the air pressure beneath the wings becomes greater than the weight of the plane so the plane rises into the air.

When you read about the Theory of Flight, you learned that planes can change their speed and direction, and that when this happens the forces of flight become unbalanced. It is important to remember, then, that if the speed of the air moving over and under the wings changes, the amount of lift also changes. Thus, one of the pilots responsibilities is to see that the right amount of lift is maintained to keep the plane aloft.

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



We accept the idea that moving air pushes things, moves sailboats, and blows hats from our heads. If we hold a piece of paper by its edge and blow against it, we expect the air to push the paper away from us and it does. But what happens if we blow air over a sheet of paper instead of against it? It goes up again! What causes this to happen?

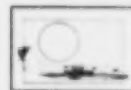
More than two hundred years ago, a Swiss scientist named Daniel Bernoulli discovered that the faster a gas moved over an object, the less pressure the gas put on the object. The slower the gas moved the more pressure it put on the object. Think of the paper again. When the air in the room was still, the air was pressing on all sides of the paper evenly. The push on one side was as much as the push on the other side. But, when we began to blow over the top of the paper, we disturbed the air on the top and pushed it quickly across. The air moved away from the paper so fast that it did not press down hard on the paper. Because we did nothing to change the air underneath the paper, it placed the same amount of pressure on the paper as before we blew. This means that the pressures on the paper were no longer equal, that the pressure below the paper was greater than the pressure above the paper. This difference in pressures gave the paper lift. The slower we blew the less the paper rose.

— continued —

Bernoulli's Principle

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



This discovery is called Bernoulli's Principle and, as we have seen, it is the key to flight. Bernoulli's discovery allowed men to design wings that could produce enough lift to rise into the air and remain there.

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



Correctly answer study questions about thrust and drag, gravity, lift, and Bernoulli's Principle based on the Information Sheet.

You will need your computer scan sheet or card to record your answers to the following Study Questions. Use a #2 pencil to mark your answers to the questions. Use rows 16-25 to mark your answers. If your answers will be hand-scored, use a blank sheet of notebook paper to record your answers and number your answers 16-25.

OBJECTIVE 2

INSTRUCTIONS



16. What is air?

- a. solid
- b. liquid
- c. gas
- d. none of the above

17. How do we know air is real?

- a. Because we can see it.
- b. Because we can feel it.
- c. Because we can taste it.
- d. all of the above

— continued —

STUDY QUESTIONS

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



18. At what part of the atmosphere is air pressure the greatest?
- a. top
 - b. middle
 - c. bottom
 - d. all of the above
19. What do we call the layer of air that surrounds the Earth?
- a. atmosphere
 - b. hemisphere
 - c. Shakespeare
 - d. none of the above
20. Why do you feel air pushing at your clothes when you ride your bike?
- a. air conditioning
 - b. air pressure
 - c. air resistance
 - d. all of the above
21. Which of the following statements expresses Bernoulli's Principle?
- a. For every action there is an equal and opposite reaction.
 - b. The faster air moves over an object the less pressure put on the object.
 - c. Hot air rises.
 - d. none of the above

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



22. What part of an airplane provides thrust?
- a. engine
 - b. wings
 - c. tail section
 - d. all of the above
23. What happens to the force of gravity as an object moves farther away from the Earth?
- a. strengthens
 - b. weakens
 - c. remains the same
 - d. none of the above
24. For an airplane to take off and remain in the air, the airplane wings must produce a lifting force.
- a. True
 - b. False
25. How is the upper surface of an airplane wing shaped?
- a. flat
 - b. straight
 - c. curved
 - d. all of the above

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



Perform an experiment demonstrating Bernoulli's Principle and explain your observations.

- Two sheets of notebook paper
- Pencil or pen

FOLLOW THESE STEPS:

STEP 1: Suspend the two sheets of paper in the air about an inch apart.

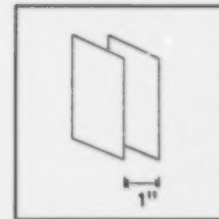
STEP 2: Blow between the two sheets of paper.

The two sheets should move together as you blow air between them.

OBJECTIVE 3

TOOLS AND MATERIALS

PROCEDURE



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 2 ACTIVITIES



FOLLOW THESE STEPS:

- STEP 3:** Explain your observation of the movement of the paper in relation to Bernoulli's Principle. Use one of the two sheets of paper you used in the experiment to record your explanation. **DO NOT LOSE THIS SHEET.** You will turn this sheet in at the end of Day 8.



If you finish Day 2 Activities with time left over, you may begin Day 3 Activities.

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

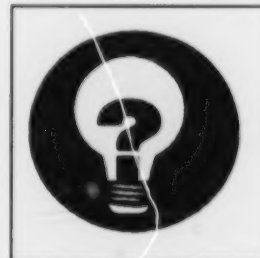
DAY 3 ACTIVITIES



On Day 3 you should complete the following activities:

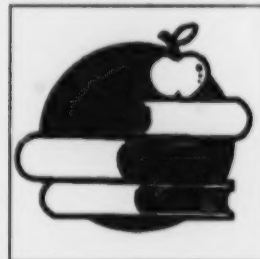
- ① Complete Objective 4
- ② Read Information Sheet
- ③ Complete Objective 5

SUMMARY OF ACTIVITIES



Creative Thinking/Problem Solving Skills

- ♦ Evaluate alternatives
- ♦ Select an alternative
- ♦ Create a finished product



Reading Comprehension Skills:

- ♦ Gain factual information

Functional Reading Skills:

- ♦ Follow written instructions

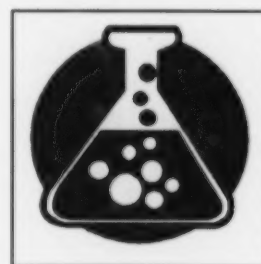
TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 3 ACTIVITIES



SUMMARY OF ACTIVITIES

Continued



General Science Skills:

♦ Apply technology

Physical Science Skills:

♦ Apply physical laws

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 3 ACTIVITIES



Design a balsa wood glider according to TSA specifications.

In today's activities you will design and build a balsa wood glider. Your glider must conform to TSA specifications and tolerances, which set limits on the type and amount of materials you may use to build your glider.

The "base" of the glider is the *fuselage*. The fuselage is the main section of a traditional aircraft, which holds the crew, passengers, and cargo. Attached to the fuselage are the *wings*, which provide most of the lift, and the *stabilizer*, commonly known as the *tail*, which helps keep the glider's flight path steady and controlled.

Aerodynamics is the study of moving air and the forces it produces. When a vehicle such as a car or airplane is called "aerodynamic," it means the vehicle is shaped in a way that creates a minimal amount of drag. For example, think of a new sportscar and an old station wagon. The sportscar's rounded shape helps it "slip" through the air with less resistance than the boxy shape of the station wagon.

An airplane's design is a compromise between aerodynamics and function. For example, the most aerodynamic shape for a fuselage is not necessarily the most practical one. However, you will not have to plan for passenger space in your glider and can concentrate on aerodynamics.

OBJECTIVE 4

INFORMATION SHEET

Parts of the glider

Glider Design

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 3 ACTIVITIES

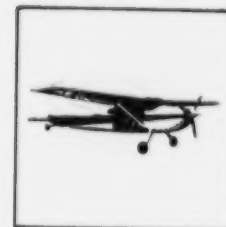


You may have seen small private airplanes that hold one or two people. The fuselage in these airplanes is generally larger in front, tapered toward the back, with smooth rounded edges. Keep this shape in mind when designing your fuselage.

Another thing to consider is the wings. Wings may be attached to the top (high-wing design), middle, or bottom (low-wing design) of the fuselage. Again, airplane designers must make a compromise between aerodynamics and function. High wings and low wings both have their own advantages and disadvantages, while mid-wing designs have characteristics of both. The high wing is more aerodynamic. If you have ever seen a full size glider, you may have noticed that it has long, slender wings. This is the best type of wing for flying long distances at low speeds.

You may also have noticed that the wings are not perfectly horizontal, but meet the fuselage at a slight angle. Tilting the wings this way is called *dihedral*. Dihedral helps provide stability to the glider. Without dihedral, a glider would tend to roll into a spiral, and eventually fly into the ground. You may design your wings at an angle or add a slight dihedral effect by adding an angled flap at each wingtip.

Wings may be supported with *struts*, thin bars that connect the wing to the fuselage. If you use struts in your glider design, they should be as light as possible.



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 3 ACTIVITIES



The tail helps provide stability and control. Again, this should be as light as possible.

The specifications and tolerances given on the next page are for use in this TLA only. There are additional regulations for gliders entered in the TSA Aerospace Technology competition.

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 3 ACTIVITIES



1. Specifications and Material Limitations

- Fuselage blank, beginning dimension 230mm length, 75mm width, 3mm thickness
- Wing blank, beginning dimension 300mm length, 74mm width, 1.5mm thickness
- Stabilizer blank, beginning dimension 75mm length, 40mm width, 1.5mm thickness

2. Specific tolerances

The glider must be constructed within the material limitations; however, all the material may be used. There are no minimum dimensions for any part.

- Fuselage must be constructed from 3mm thickness material. It may be any shape or size within the 230mm X 75mm blank and may be constructed from more than one piece or part.
- The wing must be constructed from the 1.5mm thick material. Wings may be a single part or more than one part.

TSA specifications and tolerances

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 3 ACTIVITIES



- Stabilizers must be constructed from 1.5mm thick material. Stabilizers may be a single part or more than one part.
- Rudders may be an integral part of the fuselage or constructed as a separate part. A rudder can be substituted for stabilizers constructed out of 1.5mm material.
- Placement of parts is solely at the discretion of the designer. Wings may be attached by slots or glued to the fuselage. Struts may be used, provided they are cut from the materials provided. *No additional materials may be used during construction.*
- Balance weights made from plastic clay (modeling clay) may be used and placed at any location on the glider. Weights shall be limited to 20 grams total.
- The glider model shall be all-wood (balsa) construction. No plastic, metal, or other parts may be attached to the model with the exception of balance weights.

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 3 ACTIVITIES



- 2 sheets of notebook paper
- Pencil
- Metric ruler

FOLLOW THESE STEPS:

1. On one sheet of paper, draw several small, rough sketches (*thumbnail sketches*) of glider designs.
2. Select the best design and draw it neatly on the second sheet of paper. Make sure your design conforms to TSA specifications. Write your name and hour on the paper you will hand it in to your instructor at the end of the TLA.

Continue Day 3 Activities by completing Objective 5.

TOOLS AND MATERIALS



PROCEDURE

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

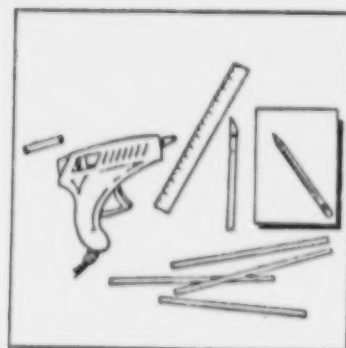
DAY 3 ACTIVITIES



Build the balsa wood glider you designed according to TSA specifications.

- Pencil
- Cutting board or mat
- Craft knife
- Balsa fuselage blank
- Balsa wing blank
- Balsa wing blank
- T-head pins, 12
- Balsa wood model glue
- 000 (fine) sandpaper

TOOLS AND MATERIALS



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 3 ACTIVITIES



FOLLOW THESE STEPS:

- STEP 1:** Draw your design on the balsa wood blanks.
- STEP 2:** Carefully cut out the glider pieces with the craft knife.

CAUTION

SEVERE CUTS POSSIBLE. Always cut away from you. **DO NOT PUSH OR PULL THE CUTTING TOOL TOWARD YOUR HAND OR BODY.**

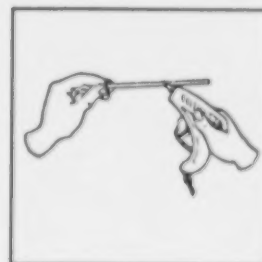
- STEP 3:** Use sandpaper to smooth the edges of the pieces.
- STEP 4:** If you are using glue, glue the glider pieces together.

CAUTION

POISONING POSSIBLE. Read instructions on glue container. **DO NOT INHALE FUMES FROM GLUE.**

- STEP 5:** Use the t-head pins to hold the pieces together while the glue is drying. Let the glue dry overnight.
- STEP 6:** Clean up your area and return all tools and materials to their proper places.

PROCEDURE



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 3 ACTIVITIES



Altitude is the distance above the Earth. To reach the proper altitude, pilots want their planes to climb, or rise farther above the Earth. Pilots can provide more thrust to the plane by increasing the engine power. The increase in thrust creates more lift and the plane begins to climb. But climbing creates more drag, so the pilot must provide even more thrust to overcome the added drag.

One way to increase lift is to change the angle of the wings. To do this the pilot must make the entire plane move. If he uses his controls to make the nose point up slightly, the wings will also point up more and the air will strike them in a different way. The angle at which the wings of a plane meet the oncoming air is called the **angle of attack**. When the pilot tilts the plane upward (increases the angle of attack), the distance the air must travel over the wings is greater than before, so the air must travel even faster. The increase in air speed decreases the pressure on top of the wings even more so the pressure on the bottom of the wings can lift the airplane to a greater altitude.

To climb, pilots pull back on the control stick to put the wings at a higher angle of attack while opening the throttle to increase thrust. (The throttle controls the power of the engine like a gas pedal in your car.)

- continued -

INFORMATION SHEET

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 3 ACTIVITIES



To **glide**, pilots reduce, or cut, the throttle. As the plane slows, lift decreases and the plane descends. To **dive**, pilots push the controls forward. This lessens the angle of attack and noses the plane down.

To maneuver the airplane in any of the ways described above, pilots must control the balance of the four forces of flight. By using their controls, pilots balance lift against gravity and thrust against drag.

If you finish Day 3 Activities with time left over, you may begin Day 4 Activities.

INFORMATION SHEET

Continued

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

On Day 4 you should complete the following activities:

- ① Complete Objective 6
- ② Read Information Sheet
- ③ Complete Objective 7

DAY 4 ACTIVITIES



SUMMARY OF ACTIVITIES

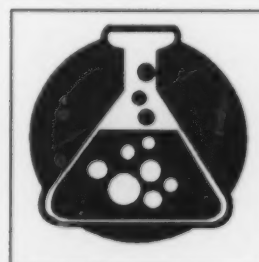


Reading Comprehension Skills:

- ◆ Gain factual information

Functional Reading Skills:

- ◆ Follow written instructions



General Science Skills:

- ◆ Apply technology

Physical Science Skills:

- ◆ Apply physical laws

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 4 ACTIVITIES



SUMMARY OF ACTIVITIES

Continued



Creative Thinking/Problem Solving Skills

- ◆ Evaluate alternatives
- ◆ Evaluate results/outcomes

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 4 ACTIVITIES



Test, modify, and record the flight of the balsa wood glider.

OBJECTIVE 6

- Balsa glider from Day 3
- Plastic (modeling) clay, 20 grams
- Stopwatch
- Paper
- Pencil or pen

TOOLS AND MATERIALS

FOLLOW THESE STEPS:

- STEP 1:** Ask your instructor where you can fly your glider. If you fly it indoors, you need a large room with at least a 20-foot high ceiling, such as a gymnasium.
- STEP 2:** Make a few practice flights with your glider. Watch to see if it stays level. If one wing always dips lower than the other, experiment by putting a small amount of clay on the higher wing. If the nose or tail dips, put a small amount of clay on the other end.

PROCEDURE

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 4 ACTIVITIES



- STEP 3:** When you are satisfied with your glider's performance, make three timed flights. Start the stopwatch as soon as you throw the glider, and stop the watch when the glider lands. Write your name, hour, and the three flight times on the piece of paper. Save this paper you will hand it in to your instructor at the end of this TLA.
- STEP 4:** Return to the classroom. Clean up your area and return all tools and materials to their proper places.

Complete Day 4 Activities by reading the Information Sheet that begins on the next page and completing Objective 7.

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 4 ACTIVITIES



INFORMATION SHEET

Changing Direction

Birds, planes, and boats all change their direction in much the same way. A boat has a rudder behind it that is bent against the moving water. Depending on which way the rudder is turned, it gets bumped harder by the water on one side than the other. This bumping swings the front of the boat around in a new direction. Birds use their tails as rudders for turning. When they want to turn left they turn their tails left. The air hitting against the tail turns the bird to the left.

When a pilot wants to turn a plane, he or she uses controls to make parts of the airplane move. Both birds and planes bank as they turn. To bank means to tilt one wing up higher than the other one. Banking makes turning easier and prevents moving off-course in the air. Pilots bank their planes by using ailerons, which are controls on the wings.

The rudder is one part of the tail which moves and assists the ailerons in a turn. The rudder is pressed against the air which is moving around the plane. Using the rudder alone would allow the plane to skid, or slide sideways, just as an automobile does on an icy or wet street.

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 4 ACTIVITIES



When an airplane does not have enough lift to keep it in the air, it **stalls**. This can happen if the pilot points the plane's nose up too high and the angle of attack is too great. Then the air flowing over the wings becomes disturbed — instead of flowing smoothly the air begins to whirl and dance on top of the wing. This turbulent air causes the plane to shudder. The plane then rapidly loses altitude and falls toward the Earth.

To recover from a stall, a pilot lowers the nose of the plane and increases speed. When the plane is moving fast enough, the pilot resumes level flight by bringing the nose of the plane to a level position.

To do all that pilots must do, they must be knowledgeable in the laws of **aerodynamics** — the study of air as it moves around objects. They must also be heavily trained and experienced.

Flying an airplane is different from driving an automobile. Planes do not ride on visible highways. And, when a pilot wants to turn a plane he or she must operate several controls at the same time; whereas car drivers simply turn a wheel.

Airplanes have three basic maneuvers, or movements:

1. pitch
2. roll
3. yaw

— continued —

Basic Movements and Controls

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 4 ACTIVITIES



Pitch is the motion of a plane as its nose moves up or down. **Roll** means that one wing dips lower than the other wing. **Yaw** is the plane's movement as the nose turns left or right. A pilot uses controls to make these maneuvers or to make adjustments because of them.

Airplanes have many controls. Four important controls are:

1. the elevator
2. the rudder
3. the ailerons
4. the throttle

The **elevator** and **rudder** are parts of the tail. The **ailerons** are on the wings. The pilot can move these parts to control the plane. Although they are on the outside of the plane, they are connected by wires or rods to the pilot's controls inside the cockpit.

The pilot turns the rudder with two foot-pedals — one pedal for left turns and the other for right turns. The ailerons and elevator are moved by a stick or wheel in front of the pilot. If the pilot wants to bank right for a right turn, then he or she moves the stick to the right. The right aileron then goes up and the left aileron goes down. The **throttle** controls the engine's speed and power.

To make any movement in a plane, a pilot seldom uses just one control. By using all the basic controls, the pilot balances lift against gravity and thrust against drag.

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 4 ACTIVITIES



Correctly answer study questions on maneuvering an airplane based on the Information Sheet.

You need your computer scan card or sheet to mark your answers to the following Study Questions. Use a #2 pencil to mark your answers on the computer scan card or sheet. Use rows 26-30. If your answers will be hand-scored, use a blank sheet of notebook paper to record your answers and number your answers 26-30.

OBJECTIVE 7

INSTRUCTIONS

STUDY QUESTIONS

26. What do airplanes and birds use for changing direction?
- a. wings
 - b. landing gear or feet
 - c. tails
 - d. all of the above
27. What happens when an airplane goes into a skid?
- a. it dives
 - b. it stalls
 - c. it slides sideways
 - d. none of the above
28. Why is a stall dangerous?
- a. the plane could break-up
 - b. the plane could fall to earth
 - c. nothing will happen
 - d. none of the above

— continued —

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 4 ACTIVITIES



29. How does a pilot bank to the right?
- a. moves the ailerons
 - b. moves the rudder
 - c. moves control stick
 - d. moves the elevator
30. "Roll" is when one wing dips lower than the other.
- a. True
 - b. False

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

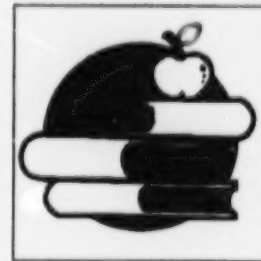
DAY 5 ACTIVITIES



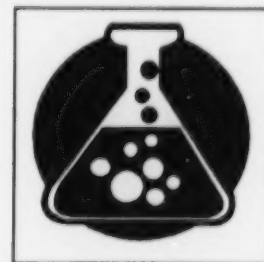
On Day 5 you should complete the following activities:

- 1 Complete Objective 8

SUMMARY OF ACTIVITIES



Functional Reading Skills:
♦ Follow written instructions



General Science Skills:
♦ Apply technology

Physical Science Skills:
♦ Apply physical laws

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 5 ACTIVITIES



Construct a flying ring using the materials and procedure provided.

OBJECTIVE 8

TOOLS AND MATERIALS

- 1 flat piece of corrugated cardboard for each person working on this TLA
- Pencil
- Compass
- Straightedge or ruler
- Record sheet (one per student)
- 50' or 100' tape measure
- Flat cutting surface (for STEPS involving cutting — DO NOT CUT MATERIALS ON WORK STATION TABLE TOPS!)
- Cutting tool

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

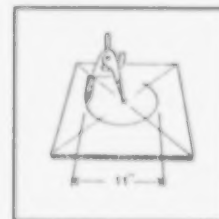
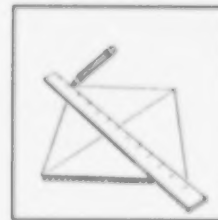
DAY 5 ACTIVITIES



FOLLOW THESE STEPS:

- STEP 1:** Obtain the materials listed on the previous page from your instructor.
- STEP 2:** Use your straight edge to draw a diagonal line from the upper left corner to the lower right corner. Draw another line from the upper right corner to the lower left corner. The point where the two lines meet is the center of your square.
- STEP 3:** Draw an 11" diameter circle on your cardboard using your compass to draw the circle with its center at the center of the cardboard. The compass should be set to make a circle with radius 5.5" (this distance is equivalent to the 11" diameter).

PROCEDURE



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 5 ACTIVITIES



FOLLOW THESE STEPS:

STEP 4: Carefully cut the disc from the cardboard square by following the circle you drew in STEP 3.



CAUTION
SEVERE CUTS POSSIBLE. Always cut away from you. DO NOT PUSH OR PULL THE CUTTING TOOL TOWARD YOUR HAND OR BODY.



STEP 5: Ask your instructor for permission to fly your disc.

Be careful not to damage your disc when you fly it. Check to make sure no one is in the flight path of your disc before each throw.

STEP 6: Fly your disc like a frisbee: level and spinning. Fly your disc three times and measure the distance each time using your tape measure. Measure the distance from the point where you released your disc into the air to the point where it first landed.

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 5 ACTIVITIES

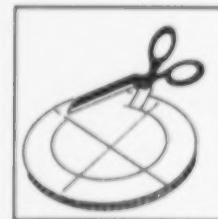


FOLLOW THESE STEPS:

STEP 7: Record the distance and flight pattern (whether your disc flew straight or curved left or right) on your record sheet.

STEP 8: Return your disc to your work station and draw a circle with diameter 8" (set your compass for radius 4"). Again, use the center point of the cardboard as the center of the circle.

STEP 9: Carefully use your cutting tool to cut along the circle you drew in STEP 8.



CAUTION
SEVERE CUTS POSSIBLE. Always cut away from you. **DO NOT PUSH OR PULL THE CUTTING TOOL TOWARD YOUR HAND OR BODY.**



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 5 ACTIVITIES



FOLLOW THESE STEPS:

Be careful not to damage your disc when you fly it. Check to make sure no one is in the flight path of your disc before each throw.

- STEP 10:** Fly your disc like a frisbee: level and spinning. Fly your disc three times and measure the distance each time using your tape measure. Measure the distance from the point where you released your disc into the air to the point where it first landed.
- STEP 11:** Record the distance and flight pattern (whether your disc flew straight or curved left or right) on your record sheet.
- STEP 12:** Experiment with the design of your ring. Make minor adjustments by simply bending the ring slightly. Again, throw the ring three times and record its distance and flight pattern.
- STEP 13:** Clean up your area and return all tools and materials to their proper places.

If you finish Day 5 Activities with time left over, you may begin Day 6 Activities.

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 6 ACTIVITIES



On Day 6 you should complete the following activities:

- 1 Complete Objective 9

SUMMARY OF ACTIVITIES



Research and Reference Skills:

- ◆ Use audiovisual media

Functional Reading Skills:

- ◆ Follow written instructions



Listening Skills:

- ◆ Apply active listening skills

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 6 ACTIVITIES



Watch the videotape *Aerobie Aerodynamics* to understand how the aerobie flying disc functions.

OBJECTIVE 9

➤ *Aerobie Aerodynamics* video tape

TOOLS AND MATERIALS

➤ VCR

➤ Monitor

FOLLOW THESE STEPS:

PROCEDURE

STEP 1: Ask your instructor where you should go to view the *Aerobie Aerodynamics* video tape.

The tape runs for approximately 37 minutes. Do not worry about trying to keep notes during the tape. You will not need to remember the mathematical equations, but do pay attention, there will be questions asked on some of the material in the tape.

STEP 2: Turn on the VCR and monitor. Put the tape in the VCR and press PLAY.

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 6 ACTIVITIES



FOLLOW THESE STEPS:

STEP 3: After you finish viewing the tape, **REWIND** the tape and return it to its proper storage case and location. Turn off the VCR and monitor.

STEP 4: Return to the Aerospace and Flight work station.

If you finish Day 6 Activities with time left over, you may begin Day 7 Activities.

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 7 ACTIVITIES



On Day 7 you should complete the following activities:

- 1 Complete Objective 10

SUMMARY OF ACTIVITIES



Functional Reading Skills:
♦ Follow written instructions



General Science Skills:
♦ Apply technology

Physical Science Skills:
♦ Apply physical laws

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 7 ACTIVITIES



Use the information you gained from the *Aerobie Aerodynamics* to make and fly your own Aerobie flying ring.

OBJECTIVE 10

TOOLS AND MATERIALS

- 1 flat piece of corrugated cardboard for each person working on this TLA
- Pencil
- Compass
- Straightedge or ruler
- Record sheet (one per student)
- 50' or 100' tape measure
- Flat cutting surface (for STEPS involving cutting — DO NOT CUT MATERIALS ON WORK STATION TABLE TOPS!)
- Cutting tool

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

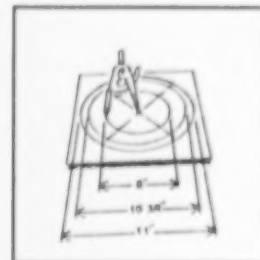
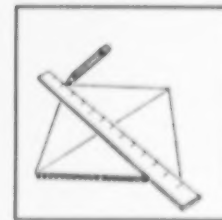
DAY 7 ACTIVITIES



FOLLOW THESE STEPS:

- STEP 1:** Obtain the materials listed on the previous page from your instructor.
- STEP 2:** Find the center of your cardboard square. Use your straight edge to draw a diagonal line from the upper left corner to the lower right corner. Draw another line from the upper right corner to the lower left corner. The point where the two lines meet is the center of your cardboard.
- STEP 3:** Draw three circles, one inside another, with the following radii:
- 5.5 inches (11" diameter)
 - 5 3/8 inches (10 3/4" diameter)
 - 4 inches (8" diameter)

PROCEDURE



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 7 ACTIVITIES



FOLLOW THESE STEPS:

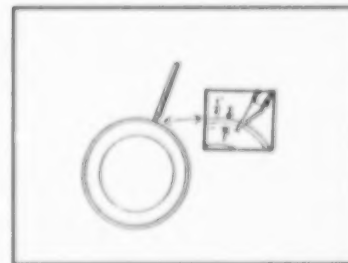
- STEP 4:** Carefully cut a ring using the cutting tool to cut along the inner and outer circles you drew in STEP 3. DO NOT CUT the 5 3/8" circle.



CAUTION
SEVERE CUTS POSSIBLE. Always cut away from you. DO NOT PUSH OR PULL THE CUTTING TOOL TOWARD YOUR HAND OR BODY.



- STEP 5:** Use the cutting tool to cut into the center corrugation at the outer edge of the cardboard. Cut to a depth of approximately 1/4 inch.



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 7 ACTIVITIES



FOLLOW THESE STEPS:

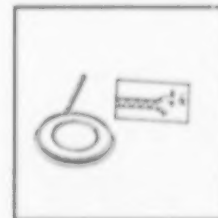
STEP 6: Lay the ring face up on your work station table top (so the 5 3/8" circle is visible). Use the plastic cap of a pen (or some other blunt tool) to crush down the inner edge of your ring all the way around. This helps to divide the airflow. **DO NOT CRUSH THE OUTER EDGE.**



STEP 7: Turn the ring upside down (so the 5 3/8" circle faces down). Bend up the outer edge of the ring until the edge is approximately 1/16" higher than the rest of the ring.



STEP 8: Hold the ring right side up (so the 5 3/8" circle is visible). Use the cutting tool to cut from the center of the corrugations to the upper, outer surface all the way around the 5 3/8" circle. **DO NOT CUT THROUGH THE LOWER SURFACE.**



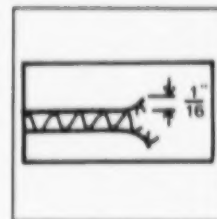
TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 7 ACTIVITIES



FOLLOW THESE STEPS:

- STEP 9:** Bend the upper, outer edge up until it is approximately $\frac{1}{16}$ " higher than the rest of the ring surface.
- STEP 10:** Ask your instructor for permission to fly your ring and for the best location to throw it.
- STEP 11:** Throw your aerobic ring backhand — like a frisbee — with a lot of wrist spin and very little arm motion. The ring should leave your hand almost perfectly level.
- STEP 12:** If your ring banks to the left, increase the amount of bend on the outer lower edge. If it banks to the right, decrease the amount of bend. (Reverse this step if you are left-handed.) Repeat this step until you get straight flights with level throws.



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 7 ACTIVITIES



FOLLOW THESE STEPS:

- STEP 13:** Record your maximum flying distance on your record sheet.
- STEP 14:** Ask your instructor for a commercial Aerobie and permission to fly it. Record the flying distance on your record sheet.
- STEP 15:** Clean up your area and return all tools and materials to their proper places. Return the manufactured Aerobie to your instructor.
- STEP 16:** Keep the aerobie ring you made and the record sheet to turn in at the end of Day 8.

If you finish Day 7 Activities with time left over, you may begin Day 8 Activities.

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

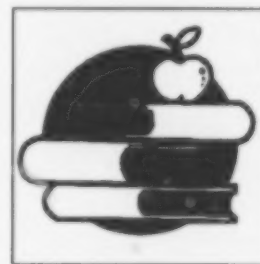
DAY 8 ACTIVITIES



On Day 8 you should complete the following activities:

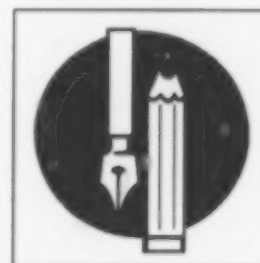
- ① Read Impact Statements
- ② Complete Career Search Activity
- ③ Complete Crossword Puzzle
- ④ Complete Word Search
- ⑤ Complete Word Jumble
- ⑥ Complete Posttest

SUMMARY OF ACTIVITIES



Functional Reading Skills:

- ♦ Follow written instructions
- ♦ Use content area vocabulary



Language Skills:

- ♦ Use correct spelling

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

Airplanes use a large amount of fuel during their takeoff, continuous flight, and landing. The burning of fuel creates pollution that has a negative impact on the environment. One way to decrease the fuel consumption of airplanes is to create more efficient airplane designs that allow airplanes to stay aloft more easily and glide through the air with less resistance.

Each year, millions of people use air travel to visit friends, relatives, or conduct business. Air travel makes socializing over great distances convenient. New designs in airplanes can help to make air travel more convenient by cutting the amount of travel time.

The effects of air travel on society are powerful. To travel from Oklahoma City to Austin, Texas by car takes approximately 7 hours. Travelling by plane takes just a little over 1 hour of flying time.

DAY 8 ACTIVITIES



ENVIRONMENTAL IMPACT



SOCIAL/CULTURAL IMPACT



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

Businesses use air travel extensively. They send representatives to meetings, ship packages, ship air mail, receive packages and air mail, and bring clients or guests to the office to talk over business matters: all of this is done with air travel with relatively little time lost to the business and the travelers. In big business, the saying "time is money" holds true. Time spent waiting for urgent packages or mail can cost businesses money, and time representatives or clients spend travelling is time they do not spend doing productive work for their companies. More efficient airplane designs that allow faster air travel save money for businesses.

Casual travelers who may be going on vacation or to visit someone can benefit economically from efficient air travel also. More efficient designs can cut fuel costs to the airline. The cut in costs can then be passed on to the consumer in the form of rate cuts for air fare.

The Federal Aviation Agency (FAA) sets guidelines on aviation safety that affect all U.S. airlines. When planes are designed, the engineers must follow those guidelines. By exceeding the FAA guidelines when a plane is designed, the designer satisfies the political considerations of the U.S. Government.

DAY 8 ACTIVITIES



ECONOMIC IMPACT



POLITICAL IMPACT



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 8 ACTIVITIES



Some ergonomic considerations in aircraft design have already been mentioned. For example, if design reduces travel for passengers, then the design accommodates their desire for speedy travel. If design reduces the effects of turbulence (irregular up and down currents of air that can give air travelers a bumpy ride), then the design makes traveling more comfortable. Speed and comfort are ergonomic concerns for aircraft.

ERGONOMIC IMPACT



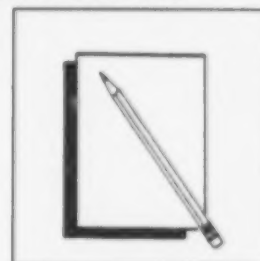
TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 8 ACTIVITIES



CAREER SEARCH ACTIVITY

INSTRUCTIONS



Using the *Career Search Abstract* read about the occupations listed below. Select the occupation that sounds most appealing to you. Write one paragraph for that occupation that explains why you might be interested in that occupation. Remember to write using complete sentences, proper grammar, and correct spelling. Give the sheet to your instructor.

- Aerospace Engineer
- Aircraft Pilot

RELATED CAREERS

AEROSPACE AND FLIGHT CAREER SEARCH ABSTRACTS

DAY 8 ACTIVITIES



AEROSPACE ENGINEER

Nature of the Occupation

Aerospace engineers design, develop, and test aircraft, space vehicles, surface effect vehicles, missiles, and systems for use in the earth's atmosphere and outer space. They play an important role in advancing technology in commercial aviation, defense systems, and space exploration.

Duties may include but are not limited to the following:

- Designing and developing commercial, military, executive, general aviation, or special-purpose aircraft
- Designing and developing space vehicles, satellites, missiles, scientific probes, or other related hardware or systems
- Overseeing the manufacture of prototypes (models)
- Testing prototypes to evaluate their operation during actual or simulated flight conditions
- Overseeing the technical phases of air transportation

Occupation Specialties

(Dot codes in parenthesis)

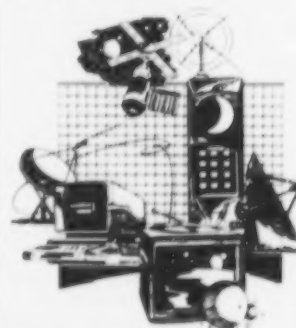
Aerodynamists (002 061-010) analyze the suitability and application of designs for aircraft, missiles, and other vehicles and systems of concern to aerospace engineers. They also plan and evaluate the results of laboratory and flight test programs.

Field Service Engineers (002 167-014) study performance reports on aircraft and recommend ways of eliminating the causes of flight and service problems in airplanes.

Stress Analysts (002 061-030) study the ability of airplanes, missiles, and components to withstand stress during flight.

Aeronautical Test Engineers (002 061-018) plan and supervise the performance testing of aerospace and aircraft products.

Aeronautical Design Engineers (002 061-022) develop basic design concepts used in the design, development, and production of aeronautical/aerospace products and systems.



Working Conditions

Aerospace engineers usually work with other engineers and scientists in modern offices. They may also spend time working in factories and on testing sites. Aerospace engineers may have to sit at drawing boards for long periods of time. They may also be subject to the noise of equipment and machinery used to test airplanes. At times, they may have to work under pressure and stress.

Aerospace engineers usually work a 5-day, 40-hour week. They may be required to work longer hours to meet deadlines. Occasionally, travel to test sites may be necessary.

Aerospace engineers may join professional organizations such as the American Institute of

Aeronautics and Astronautics and the National Society of Professional Engineers. Members usually pay dues.

Tools, Equipment and Materials used may include:

- Blueprints
- Specifications
- Preliminary Plans
- Light Tables
- Charts and Handbooks
- Measuring Scales
- Weight Scales
- Drafting Tools
- Computers

Worker Requirements

You should like:

- Activities of a scientific and technical nature
- Activities of a creative and abstract nature

You should be able to:

- Perform a variety of duties which may often change
- Think logically and use good judgment
- Work within precise limits and standards of accuracy
- Understand and use mathematics and engineering principles and methods
- Visualize three-dimensional objects from drawings or diagrams
- Compare and see differences in the size, shape, and form of lines and objects
- Understand the meanings and relationships of words and use language effectively

Physically you must:

- Have speech and hearing depending upon area of work
- See well, either naturally or with correction
- Be able to reach, handle, finger, and feel

OCCUPATION SPECIALTIES

DOT CODE

002 061-014 Aeronautical Engineer
002 061-010 Aerodynamist
002 061-022 Aeronautical Design Engineer
002 061-026 Aeronautical Research Engineer

SOC CODE 1622

002 167-014 Field Service Engineer
002 061-030 Stress Analyst
002 061-018 Aeronautical Test Engineer

OKLAHOMA
**CAREER
SEARCH**



AEROSPACE ENGINEER

Special Requirements

Aerospace engineers who have primary responsibility for a project or who must sign off a contract generally are required to be licensed by the state in which they work. It is also highly desirable for those doing consultant work to be licensed.

Opportunities for Experience

Opportunities for experience and exploration are available through work study programs at colleges and universities and service in the United States Air Force. Summer or part time work with research laboratories, manufacturing plants, and construction projects will provide an idea of what engineering is all about.

Methods of Entry

Methods of entering this occupation include direct application to employers and civil service offices. Assistance in locating a job may be available through college and university placement offices.

Earnings and Advancement

Earnings depend on the individual's education, experience, field of specialization and job duties.

Earnings

Aerospace engineers graduating with a bachelor's degree earned a starting salary of \$30,600 in 1990. Experienced aerospace engineers earned salaries ranging from \$32,160 to \$95,545 annually. The national average income of aerospace engineers was \$47,454 in 1990. In 1990, the average salary for all engineers in the Federal Government was \$45,970.

Fringe Benefits

Depending on the employer, aerospace engineers may receive paid vacations and holidays, life, accident, disability, and hospitalization insurance, retirement plans, and sick pay. These

benefits are usually paid for, at least in part, by the employer.

Career Ladder for this Occupation may look like this:

- Chief Engineer
- Aeronautical or Astronautical Engineer
- Trainee

Aerospace engineers may advance to administrative and other executive positions or become consultants.

Employment and Outlook

There were approximately 78,000 aerospace engineers employed nationally in 1988. Employment is expected to grow as fast as the average for all occupations through the year 2000. Contracts for new military aircraft, missiles, and other aerospace systems are not expected to grow much, but faster growth is expected in the areas of airline replacement, spacecraft, helicopters and business aircraft. Most job openings will come from the need to replace aerospace engineers transferring to other occupations or leaving the labor force.

Aerospace Engineers held about 345 jobs in Oklahoma during 1986. That number is expected to increase to 369 by 1992, which represents a 7.24 percent change. Job openings each year for Aerospace Engineers will equal approximately 15, with 11 of those due to replacements and 4 created through new jobs.

Related Education and Training

Level(s) of education and training usually needed for this occupation:

- College bachelor's degree
- College master's degree

Level(s) of education and training also available for this occupation:

- College Ph.D. or professional degree

School subjects helpful in preparing for this occupation include:

- College Preparatory
- Algebra
- Geometry
- Trigonometry
- Physics
- English
- Calculus
- Statistics
- Chemistry
- Electricity & Electronics

More Sources of Information

- National Society of Professional Engineers
1420 King Street
Alexandria, VA 22314
- Junior Engineering Technical Society (JETS, Inc.)
1420 King Street, Suite 405
Alexandria, VA 22314-2715
- College Placement Offices
- Military Recruiters

AEROSPACE AND FLIGHT CAREER SEARCH ABSTRACTS

DAY 8 ACTIVITIES



AIRPLANE PILOT



Nature of the Occupation

Airplane pilots operate airplanes for airlines, general aviation, or the military to transport passengers and cargo or for other purposes.

Duties may include but are not limited to the following:

- Reviewing and examining papers to determine necessary flight data
- Ordering changes in fuel supply, loading, routing or scheduling to ensure safety of flight
- Contacting control tower by radio to receive takeoff clearance and instructions
- Controlling the airplane in flight
- Logging flight information

Occupation Specialties

(Dot codes in parenthesis)

Airplane-Patrol Pilots (196 263-014) fly over pipelines and communications systems to detect leaks, breaks, washouts or other damage.

Test Pilots (196 263-042) fly new, experimental and modernized aircraft to determine their safety.

Agricultural-Aircraft Pilots (196 263-010) fly at low altitudes over agricultural fields to dust or

spray them with seeds, fertilizers or pesticides.

Executive Pilots (196 263-030) fly company-owned aircrafts.

Working Conditions

The captain of an airplane is in charge of the plane and supervises all other crew members.

Airplane pilots generally work in confined but comfortable, well-ventilated and well-lighted compartments and are surrounded by instruments, levers, and switches.

Airplane pilots employed by commercial airlines are limited to not more than 85 hours a month by the Federal Aviation Administration (FAA). Most airline pilots actually fly less than 70 hours a month and, although they have additional nonflying duty hours, usually work 16 days a month. Pilots not employed by airlines are restricted to flying no more than 100 hours a month.

Although flying does not involve much physical effort, the mental stress of being responsible for a safe flight, no matter what the weather, can be tiring. Particularly during takeoff and landing, pilots must be alert and quick to react if something goes wrong.

Airplane pilots may join the Air Line Pilots Association.

International Members usually pay dues.

Tools, Equipment and Materials used may include:

- Airplane and its Basic Instruments
- Flight Computers
- Transponders
- Logbook
- Charts, Records and Reports
- Radar Equipment
- Radios and Public Address Systems
- Flight Recorders
- Engine and Airframe Logs
- Flight Plan

Worker Requirements

You should like:

- Activities dealing with things and objects
- Activities relating to processes, machines and techniques

You should be able to:

- Perform a variety of duties which may often change
- Reason logically and use logical step-by-step procedures
- Make decisions quickly and accurately under pressure
- Perform mathematical operations quickly and accurately
- Understand the meanings and relationships of words and use language effectively
- Understand two-dimensional representations of three-dimensional objects

Physically you must:

- Maintain excellent health with outstanding physical stamina
- See well, either naturally or with correction
- Hear well, either naturally or with correction

OCCUPATION SPECIALTIES

DOT CODE:

196 263-010 Airplane Pilot

196 263-014 Commercial Airplane Pilot

196 263-014 Airplane-Patrol Pilot

196 263-042 Test Pilot

196 263-010 Agricultural-Aircraft Pilot

196 263-030 Executive Pilot

SOC CODE: 825

OKLAHOMA
CAREER
SEARCH

AEROSPACE AND FLIGHT CAREER SEARCH ABSTRACTS

DAY 8 ACTIVITIES



AIRPLANE PILOT

- Possess good eye-hand-foot coordination
- Manipulate small objects rapidly and accurately
- Measure from 5'6" to 6'4" tall and be proportional in height and weight

Special Requirements

All pilots who are paid to transport passengers or cargo must have at least a commercial pilot's license from the Federal Aviation Administration. In addition to a commercial license, pilots who fly in bad weather must be licensed by the FAA to fly by instruments. Airline captains must have an FAA airline transport pilot's license.

Opportunities for Experience

Completion of pilot training offered by private schools, flying clubs, colleges and universities, and all branches of the armed services offer opportunities for experience.

Methods of Entry

Methods of entering this occupation include direct application to employers and government agencies. Positions may also be located by consulting employment ads in aviation trade magazines.

Earnings and Advancement

Earnings depend upon the employing airline, number of hours and miles flown, size, speed and type of plane, length of service and type of flight (commercial or domestic).

Earnings

Although the average salary for pilots ranges from approximately \$45,000 to \$77,000 a year, experienced airline pilots earned an average salary of \$87,000 a year in 1990. Captains employed by major airlines earned approximately \$116,000 annually, while senior captains on the largest aircraft earned as much as \$179,000. Generally, pilots

working outside the airline industry earned lower salaries.

Fringe Benefits

Depending on the employer, airplane pilots may receive paid vacations, dental, disability, life and hospitalization insurance, and pension plans. These benefits are usually paid for, at least in part, by the employer. Pilots employed by airlines may also receive free or reduced fare flights for themselves and family members.

Career Ladder for this Occupation may look like this:

- Captain
- First Officer (Co-Pilot)
- Second Officer (Flight Engineer)

Airplane pilots may advance through seniority and administrative and leadership ability.

Employment and Outlook

There were approximately 83,000 airplane pilots employed nationally in 1988. Employment is expected to grow faster than the average due to a shortage of qualified pilots. College graduates who have experience flying jet aircraft and who have a commercial pilot's license and a flight engineer's license can expect first consideration for their jobs with major airlines.

Airplane pilots held about 394 jobs in Oklahoma during 1986. That number is expected to increase to 414 by 1992, which represents a 5.06 percent change. Job openings each year for airplane pilots will equal approximately 10, with 7 of those due to replacements and 3 created through new jobs.

Related Education and Training

Level(s) of education and training usually needed for this occupation:

- Technical junior or community college
- College bachelor's degree

School subjects helpful in preparing for this occupation include:

- College Preparatory
- Algebra
- Geometry
- Physics
- Trigonometry
- Blueprint Reading
- Geography

More Sources of Information

- Air Transport Association of America
1709 New York Avenue, NW
Washington, DC 20006
- Aircraft Owners and Pilots Association
421 Aviation Way
Frederick, MD 21701-4798
- International Society of Women Airline Pilots
P.O. Box 38644
Denver, CO 80238
- Airline Pilots Association
535 Herndon Parkway
Herndon, VA 22070
- Future Aviation Professionals of America
4959 Massachusetts Blvd.
Atlanta, GA 30337-9806
- Airline Employees Association
5600 South Central Avenue
Chicago, IL 60638

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 8 ACTIVITIES



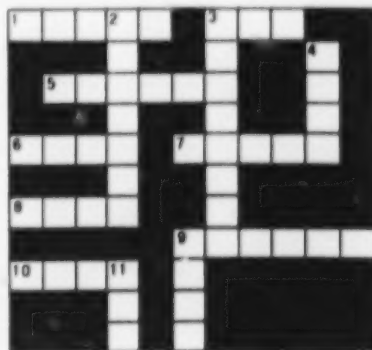
CROSSWORD PUZZLE

Across

1. Motion of an aircraft as its nose moves up or down. It is all around us every day.
3. An engine that does not require outside oxygen.
6. Increases lift and helps in takeoff and landing.
7. What an aircraft does when it does not have enough lift to stay in the air.
8. Without this force we could not fly.
9. Measure of the force exerted by gravity.
10. Mostly friction caused by air pushing back against an aircraft as it moves forward.

Down

2. Part of the aircraft where the pilot rides.
3. Distance above the earth.
4. When one wing dips lower than the other.
9. Part extending from each side of the body of an airplane that creates lift.
11. Air is a _____.



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 8 ACTIVITIES



WORD SEARCH

Find the hidden words in this word search and circle them. The words may appear across, down, backwards, or diagonally.

INSTRUCTIONS

W A B C T F A R C R I A
D M C E F G H O I J K L
M R O C K E T L N O B P
Q R C N O O L L A B A S
T U K O T V W O X Y L T
Z A P O B G C P D E Y H
F G I M H I O A J K K G
L M T N O P I L O T S I
P Q R T H G I L F R S R
L I N D B E R G H I T W
U V W X Y Z Z T R A E A
S P A C E C R A F T R R

Find these words:

AIR	MOON
MONTGOLFIER	PILOT
COCKPIT	APOLLO
ROCKET	AIRCRAFT
FLIGHT	WRIGHT
SPACECRAFT	BALLOON
SKYLAB	LINDBERGH

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

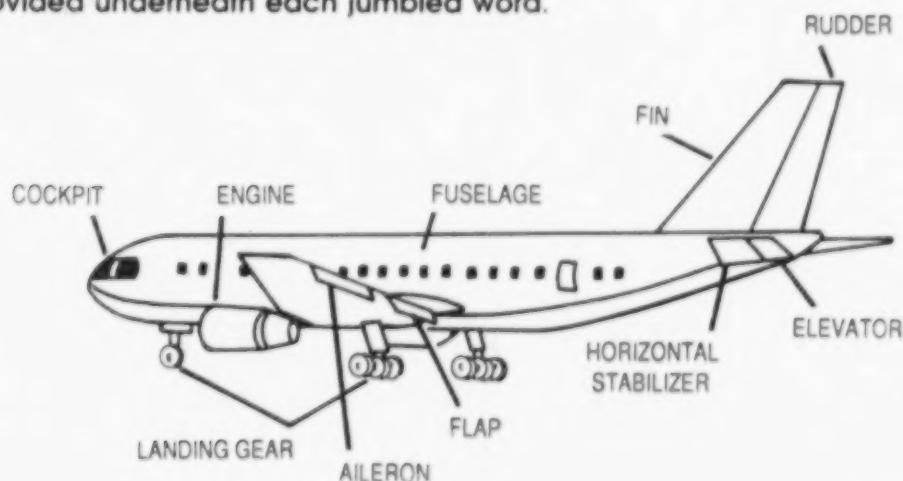
DAY 8 ACTIVITIES



WORD JUMBLE

INSTRUCTIONS

Look at the figure below for the correct spelling of the parts of an airplane. Then, unscramble the words below the figure so they spell out one of the airplane parts. Place the correct spelling in the space provided underneath each jumbled word.



DRRUDE

RONAEIL

INF

LAEGUFSE

TLAZNOIORH REZILIBATS

NGIENE

PTCCOKI

ATVLEREO

DNIGNLA ERAG

PFLA

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

DAY 8 ACTIVITIES



You will need a computer scan sheet or card to record your answers to the following Posttest. Be sure to write your name, the title of the TLA, the date, and the class period on the computer scan sheet or card using a #2 pencil. Use rows 31-45 to record the answers to the Posttest. If your answers will be hand-scored, use a blank sheet of notebook paper to record your answers and number your answers 31-45.

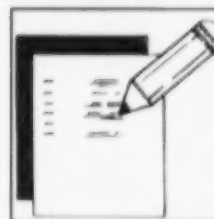
Get Posttest Questions from your instructor.

When you finish the Posttest, return the test form and the computer test card or notebook paper to your instructor.

If you finish Day 8 Activities with time left over, you may begin the Skunk Works Activity.

POSTTEST

INSTRUCTIONS



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

SKUNK WORKS



The term *Skunk Works* comes from an engineering division of the 3M Company. In the late 1960s a group of engineers at 3M wanted to design a new product, but the managers of the company would not give them the money for research. So they decided to design the product anyway, then try to convince the company to make it. Whenever the engineers could grab a few extra minutes from their regular assignments, they worked on the new product. In early 1969 they presented it to the marketing division of 3M, and the company has been selling it ever since. The product: Velcro fasteners.

Using the materials and the procedure outlined below build a glider and use what you have learned in this TLA to control its path of flight.

BACKGROUND

SKUNK WORKS CHALLENGE

TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

SKUNK WORKS



TOOLS AND MATERIALS

- Cutting tool
- One or two pieces of foam from a fast food take-out tray (there should be enough foam to cut out the shapes on page 88 of this TLA).
- Ballpoint pen
- Penny
- Tape

FOLLOW THESE STEPS:

- STEP 1:** Get a copy of the pattern on page 88 from your instructor. **DO NOT CUT THE PATTERN ON PAGE 88 FOR THIS ACTIVITY, CUT THE COPY!**
- STEP 2:** Cut out the wing and the fuselage from the foam using the pattern you obtained from your instructor.

PROCEDURE

CAUTION
SEVERE CUTS POSSIBLE. Always cut away from you. **DO NOT PUSH OR PULL THE CUTTING TOOL TOWARD YOUR HAND OR BODY.**



TECHNOLOGY EDUCATION AEROSPACE AND FLIGHT

SKUNK
WORKS



FOLLOW THESE STEPS:

Elevons will serve as both ailerons and elevators for your glider.

- STEP 3:** Mark the elevon hinges with the ball point pen. Use medium pressure. The idea is to crease the foam so you can bend the elevons to control the flight of your glider.
- STEP 4:** Cut a slot in the fuselage.
- STEP 5:** Slide the wing in the slot. It should fit snugly.
- STEP 6:** Tape your penny to the nose of the glider. The penny will act as a balance.
- STEP 7:** Ask your instructor for permission to fly your glider. Then, after making sure nobody is in the flight path, fly your glider.
- STEP 8:** Bend the elevons up and down as desired to change your glider's path.
- STEP 9:** When you finish, clean work area and return tools and materials to their proper storage area.

